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Financial and Operating Performance of Cooperative Unit-Train Shippers in North Dakota

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Highlights

This study analyzes performance of unit-train shipping cooperative elevators in North Dakota. Financial data from 1978-1986 were used to derive measures of performance and comparisons are made between single-and multiple-plant firms. Results indicate that financial and operating performance varies between firm type and geographic location. Further return on equity has declined since 1981. Minimum average total costs were higher for multiple-plant firms and were reached when grain volume was six to seven times that of single-plant firms.

FINANCIAL AND OPERATING PERFORMANCE OF COOPERTIVE UNIT-TRAIN SHIPPERS IN NORTH DAKOTA

Bradley B. Clow and William W. Wilson*

I. Introduction

There have been important developments in the past 10 years which have impacted the country grain handling industry in North Dakota. These include sporadic demand, increasing in the 1970s and declining in the early 1980s, changes in government farm programs, railroad deregulation, and adoption of unit-train shipping facilities. The response of some firms has been to merge with others operating as satellite facilities, whereas others have opted to expand and operate as single-plant enterprises. These developments and responses have impacted both the structure of the industry in terms of increased concentration, and the financial and operating performance of individual firms.

The overall purpose of this study is to analyze the financial performance of the country grain handling industry in North Dakota during this time period. Specific objectives include:

1) To calculate ratios of financial and operating performance in the country grain handling industry. These ratios are used to identify changes which have occurred through time. Differences are also identified in performance by region and between single- versus multiple-plant firms.

2) To analyze costs and the relationship between costs and output of the industry.

The analysis and results reported in this study are limited to cooperatives in North Dakota. Cooperatives comprise approximately 70 percent of the elevators in North Dakota and therefore the results are considered representative of trends in the industry. Background information on developments which have had an impact on the country elevator industry are discussed below. In Section II the data sources are discussed and financial and operating ratios are calculated and presented. Comparisons of costs are made in Section III along with evaluation and analysis of the relationship between cost and output. A summary of the results and implications are discussed in Section IV.

Industry Description

Due to the diversification of grain produced in North Dakota, grain elevators must be able to handle relatively large quantities of grain but on a

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segregated basis. Therefore, local country elevators must perform necessary services to enhance the economic value of grain they handle. These services may include storage, cleaning of grain, grading, blending, or segregation of different qualities of grain. Along with the above services, country elevators often serve as farm supply outlets for chemicals and fertilizers.

Most North Dakota elevators around the turn of the century were line facilities (groups of elevators owned by large out-of-state millers or commission firms) whose function was to originate grain quickly. The common features of these elevators were small storage capacity, on the average 20,000 to 30,000 bushels, with a single conveyer leg comprised of small rope-elevated buckets powered by a small horsepower engine (Benton and Peightal). During this period no cleaning of grain was done, and the loading of cars was accomplished through a hopper scale.

The relationship between farmers and grain elevators was not always congenial. Railroads commonly gave preference to line elevators over independently-owned firms. Therefore, farmers began to voice their disapproval of line elevators and expressed a greater desire for more say in their own economic fate. As a result of this disapproval, local grain elevator cooperatives were organized. By the turn of the century, there were only a few cooperatives in the state, however, by 1915 the state possessed some 264 cooperatives (Benton and Peightal).

The 1920s and 1930s were particularly difficult years financially for farmers and grain elevators. Significant growth in the number of farmer-owned grain cooperatives was observed during these years. The early founders of farm cooperatives desired to dispose of the middle man and purchase directly from wholesalers. Savings could then be passed directly to the patrons of the cooperative through higher commodity prices or as patronage dividends.

The principal forms of ownership structure of grain elevators in North Dakota are cooperative or corporate (private). In the most recent survey (1979), 66 percent of the firms interviewed were cooperatives with the remaining 34 percent being privately owned. It was found that the majority of cooperative elevators (78 percent) had capacities between 100,000 and 400,000 bushels, compared to only 58 percent of the private companies in this capacity range. However, a greater number of private firms were either small (100,000 or less) elevators or large elevators (800,000 or greater) as compared to cooperatives (Benton and Peightal).

The development of the North Dakota elevator industry is very similar to that in other states. Over time there has been a decline in the number of licensed plants, and an increase in the average storage capacity (Table 1). The increase in storage capacity can be attributed in part to some of the government programs.

TABLE 1. NUMBER OF ELEVATORS AND AVERAGE STORAGE CAPACITY, NORTH DAKOTA, 1922-1986

Year	Licensed Elevators	Total Storage Capacity	Average Storage Capacity
		--------thousand bushel--------	
1915	2,031	NA	NA
1922	1,832	NA	NA
1953	936	63,865	68.4
1965	779	128,066	164.1
1970	658	129,300	196.1
1975	617	126,004	204.2
1976	605	133,334	219.8
1977	600	137,630	229.4
1978	587	143,153	243.6
1979	589	146,022	247.9
1980	592	155,885	263.3
1981	589	156,471	265.7
1982	578	166,193	287.5
1983	582	177,452	304.9
1984	563	177,992	316.1
1985	577	199,108	345.1
1986	573	235,510	411.0

SOURCE: Directory of Licensed and Bonded Country Elevators in North Dakota, North Dakota Grain Dealers Association, Fargo, ND, various issues.

Government Program Impacts

Government farm programs have had important impacts on the financial and operating performance of the country grain handling industry. These impacts can be categorized along two themes. One is through the impact on farm production and marketing, and therefore, elevator throughput; the other is through the storage market.

A series of events in 1972 and 1974 changed the economic and technical environment in which agriculture operates. These events affected the level of production and the workings of the marketing system, as well as its participants. First, was the rise in world grain demand, starting in 1972 with expanded export sales. Second, was the quadrupling of crude oil prices between 1972 and January 1, 1974. A combination of the surge in exports in 1972/73 which sharply reduced United States grain stocks, and a relatively poor crop year in the United States led to higher grain prices in the U.S. and

the rest of the world. Thus, supply conditions and worldwide inflation, fueled by the rise in oil prices combined with government expansionary fiscal and monetary policy, contributed to higher grain prices. Due to increases in exports and depletion of government grain stocks, most of the cropland which was previously idled was placed back into production. There were increases in production in the U.S. and abroad in response to the higher prices of the early 1970s. Prices subsequently fell and since then there have been periodic supply control programs. These have had an important impact on production and therefore, elevator throughput.

Acreage reduction programs in place since 1976, along with selected data on production in North Dakota are shown in Tables 2 and 3 for wheat and barley, respectively. For certain years there were other programs which are not listed (only ARP is listed) but also resulted in reduced plantings. Generally, wheat acres harvested have been lower since 1981 than previous years. However, yields increased dramatically leaving production levels relatively unchanged. The only exception was the PIK program of 1983 which resulted in drastically reduced plantings and lower production levels. Barley production in North Dakota has been increasing throughout the 1980s. The number of harvested acres has increased from 1.5 to 3.5 million acres from 1980 to 1986 which has increased production levels from 48 to 176 million bushels, respectively. As a result, farm programs have had less effect on reducing production of this crop.

TABLE 2. ACREAGE REDUCTION AND IMPACTS ON WHEAT PRODUCTION AND MARKETING IN NORTH DAKOTA

Crop Year	Acreage Reduction	Acres Harvested	Yield Per Acre	Production	Shipments[1]	Ratio of Shipments to Production
	-percent-	-million-	---bu---	--- million bushels ---		--percent--
1976	--	11,655	24.7	287,830	190,111	66
1977	--	9,254	24.8	229,907	206,311	90
1978	20	9,585	29.8	286,065	273,494	95
1979	20	9,600	26.3	252,235	264,121	105
1980	--	9,620	18.7	179,650	189,309	105
1981	--	11,690	28.4	331,700	230,050	69
1982	15	10,490	31.5	330,785	240,728	73
1983	20-100*	7,220	27.0	194,595	248,245	127
1984	30-50	8,660	32.8	284,198	263,779	93
1985	30	8,870	36.4	323,255	268,432	83
1986	25-35	9,380	30.9	289,820	298,930	103

*Payment in Kind Program.

[1]Upper Great Plains Transportation Institute, North Dakota Agricultural Statistics.

TABLE 3. ACREAGE REDUCTION AND IMPACTS ON BARLEY PRODUCTION AND MARKETING IN NORTH DAKOTA

Crop Year	Acreage Reduction	Acres Harvested	Yield Per Acre	Production	Shipments[1]	Ratio of Shipments to Production
	-percent-	-million-	---bu---	--- million bushels ---		--percent--
1976	0	2,140	38.0	81,320	73,226	90
1977	0	2,530	39.0	98,670	63,108	64
1978	10	2,450	46.0	112,700	69,348	61
1979	20	1,650	46.0	75,900	78,621	104
1980	0	1,500	32.0	48,000	62,672	131
1981	0	2,200	48.0	105,600	79,801	76
1982	10	2,040	53.0	108,120	65,751	61
1983	20-100	2,700	46.0	124,200	106,645	86
1984	10	2,900	53.0	153,700	106,030	69
1985	10	3,350	55.0	184,250	105,435	57
1986	20	3,450	51.0	175,950	146,341	83

[1]Upper Great Plains Transportation Institute, North Dakota Agricultural Statistics.

The ratio of shipments to production is presented for both wheat and barley in Tables 2 and 3. It was observed during years of lower than normal production (i.e., 1980 and 1983 for wheat and 1979 and 1980 for barley), the ratio was greater than 100 for both wheat and barley meaning more grain was leaving the state than was produced during those years. Also in 1986, due to the PIK and Roll program, the ratio of shipments to production increased for wheat at 103 and barley at 83. The ratio of shipments to production for barley has increased less than wheat due to the substantial increase in barley production in recent years.

Grain and oilseed shipments are presented in Table 4. Grain shipments increased by 76 percent from 1976 to 1983. The rise in shipments can be attributed in part, to the growth in sunflower production. In 1983, record grain and oilseed shipments were observed in North Dakota. However, shipments have been more erratic in recent years. A decline in grain movement was observed for both 1984 and 1985 with a dramatic increase in grain shipments, due to the PIK and Roll program, observed in 1986.

The most recent government program impact on the elevator industry has been the introduction of PIK and Roll. Both elevator managers and farmers have been able to redeem grain out of loan or reserve program and sell on the cash market. This in effect increased grain throughput for most grain elevators in the 1986 crop year, despite lower production. Elevators were not only moving more grain in 1986, but were supplementing their incomes by trading PIK certificates. Since the introduction of PIK certificates and PIK and Roll alternatives, country grain elevators had the opportunity in 1986 to generate greater grain throughput and ultimately higher profits.

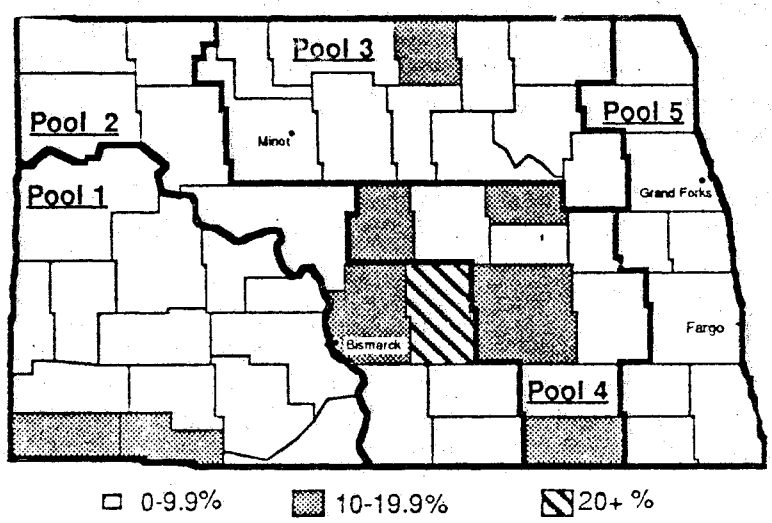
TABLE 4. NORTH DAKOTA GRAIN AND OILSEED SHIPMENTS 1976-1986

Year	Hard Red Spring	Durum	Barley	Sunflowers	Oats	Soybeans	Flaxseed	Misc.	Corn	Total
	thousand bushels									
1976-77	123,976 (41%)	65,024 (21%)	73,314 (24%)	15,622 (5%)	12,158 (4%)	1,941 (1%)	4,883 (2%)	8,994 (3%)	N.A.	305,912 (100%)
1977-78	127,953 (36%)	88,366 (25%)	63,115 (18%)	51,278 (14%)	10,492 (3%)	1,776 (1%)	6,174 (2%)	9,450 (3%)	N.A.	358,604 (100%)
1978-79	184,923 (41%)	88,659 (19%)	69,648 (15%)	79,253 (17%)	12,087 (3%)	2,943 (1%)	4,541 (1%)	14,180 (3%)	N.A.	456,234 (100%)
1979-80	169,573 (36%)	94,581 (20%)	78,621 (17%)	95,940 (20%)	7,959 (2%)	5,452 (1%)	4,580 (1%)	19,358 (4%)	N.A.	476,064 (100%)
1980-81	126,115 (31%)	63,193 (16%)	62,672 (15%)	114,866 (28%)	3,515 (1%)	3,109 (1%)	4,176 (1%)	9,498 (2%)	13,941 (3%)	401,085 (100%)
1981-82	148,169 (32%)	81,881 (17%)	79,801 (17%)	111,496 (24%)	8,379 (2%)	5,801 (1%)	3,644 (1%)	12,232 (3%)	10,460 (2%)	461,862 (100%)
1982-83	178,800 (36%)	79,132 (16%)	70,106 (14%)	121,744 (25%)	10,583 (2%)	7,687 (2%)	4,883 (1%)	8,219 (2%)	10,518 (2%)	491,671 (100%)
1983-84	163,305 (30%)	84,941 (16%)	106,645 (20%)	103,449 (19%)	21,261 (4%)	12,504 (2%)	4,235 (1%)	10,014 (2%)	32,463 (6%)	538,818 (100%)
1984-85	183,109 (36%)	80,670 (16%)	106,030 (21%)	77,412 (15%)	11,232 (2%)	14,292 (3%)	4,098 (1%)	12,389 (2%)	22,623 (4%)	511,855 (100%)
1985-86	181,089 (38%)	87,344 (18%)	105,436 (22%)	53,541 (11%)	7,706 (2%)	12,116 (3%)	5,503 (1%)	12,261 (3%)	13,394 (3%)	478,390 (100%)
1986-87	193,962 (34%)	104,968 (18%)	146,342 (26%)	61,067 (11%)	9,387 (2%)	9,990 (2%)	6,666 (1%)	12,500 (2%)	26,437 (5%)	571,319 (100%)

SOURCE: Upper Great Plains Transportation Institute.

The Conservation Reserve Program (CRP) was introduced in 1986 to take less productive, marginal land out of production. The land that is eligible for this program has highly erodable soil as determined by the Soil Conservation Service. Most participants eligible for the CRP program are located in western and east central North Dakota. The impact of the CRP program may have dramatic effects in the next 10 years on country grain elevators in those regions. The problem of variation in production is largely determined by yield variability and area planted, the latter being influenced to a great extent by farm programs.

The CRP program impacts of 1988 are presented in Figure 1. The state is divided into five pool areas (ND ASCS). Pool 2 has greatest participation with 435,797 acres entering the program. Between 10-19 percent of the total acreage was placed into the CRP program in Burleigh County and over 20 percent in Kidder County. In Pool 4, the next largest CRP signup was observed. In this region 285,288 acres were placed into the CRP program. There are a greater number of unit-train shippers in this region as compared to Pool 2. Since the elevator industry is characterized by tremendous economies of throughput, variability in shipments has an important impact on financial and operating performance.



Area	Acres in 1st 4 sign-ups	Acres in 5th sign-up	Total acres
Pool 1	135,158	129,048	264,206
Pool 2	186,939	248,858	435,797
Pool 3	131,961	139,517	271,478
Pool 4	144,832	140,456	285,288
Pool 5	113,880	77,939	191,809

Figure 1. Conservation Reserve Program In North Dakota

SOURCE: ND ASCS.

Farm programs also impact the elevator industry through the storage market. During the 1950s the Commodity Credit Corporation (CCC) stepped up efforts to increase the building of grain storage facilities. In a 1966 study, Velde and Taylor analyzed the storage capacity in North Dakota and found that the increases in the 1950s were a direct result of Commodity Credit Corporation's storage program, which increased the payment rate to elevators to build storage facilities.

To provide storage services, during the period of 1977 through 1986, many elevators increased their storage capacity. The Farmer Owned Reserve Program, introduced in 1977, provided the incentive to build storage by paying 26.5 cents per bushel per year to store government-owned grain. Government storage provided a relatively low risk and steady source of income to cooperative elevators. As a result, total elevator storage capacity in the state grew from 133.3 in 1977 to 215.5 in 1986. In addition to providing impetus to expand off-farm storage, the Farmer Own Reserve (FOR) encouraged expansion of on-farm storage. Under this program farmers would receive storage payments for grain stored in the reserve and the Secretary of Agriculture was authorized to waive interest charges on grain in the reserve (Cramer). An increase in on-farm storage has also resulted from these programs. On-farm stocks are a good indicator of on-farm storage capacity (Table 5). Stocks stored on farm grew from 198 million bushels in September of 1975 to a high of 432 million bushels in September of 1982, suggesting an increase in on-farm storage capacity of 218 percent, though production only increased 20 percent.

Government farm programs have had two important implications for the country grain elevator industry. One influence is through supply control measures which have the impact of reducing throughput, and possibly increasing the variability in shipments. The second influence is through the storage market. The elevator industry, in general, benefited from the favorable storage policies in the late 1970s, as did producers, as represented by increases in both on- and off-farm storage capacity. However, as stocks are being reduced in recent years through reduced production and expanded exports, the amount of excess storage and handling capacity is likely to increase.

Railroad Legislation

During the last 10 years the country elevator sector in North Dakota has also been affected by changes in the railroad industry. Prior to 1980, rail rates were influenced by market phenomena but subjected to the regulations of the Interstate Commerce Commission (Casavant and Griffen). During 1976 the Railroad Revitalization and Regulatory Reform Act was passed which provided for relaxation of railroad rates and changes in the regulation of railroad abandonments and mergers. In 1980 the Staggers Rail Act was passed, providing for substantial reform of railroad regulation. Heavy emphasis on reducing the amount of regulation of railroad rates was included.

TABLE 5. TOTAL WHEAT STOCKS ON FARMS, NORTH DAKOTA, 1960-1986

Year	January	April	July	September
	----------	million bushels	----------	
1960	67	48	20	102
1965	116	93	48	177
1970	212	181	116	195
1975	111	84	35	198
1976	--	--	--	--
1977	207	175	161	298
1978	246	209	156	314
1979	271	243	180	317
1980	242	194	138	213
1981	179	154	116	334
1982	275	249	196	432
1983	354	298	237	267
1984	242	215	174	329
1985	255	215	193	381
1986	323	268	235	350

SOURCE: North Dakota Agricultural Crop and Livestock Reporting Service, "North Dakota Agricultural Statistics," Various Issues.

There were two important changes in the country elevator industry as a result of this legislation. One was the advent of rail contracting, the other was the expanded use of unit-train rates. Prior to 1980 all shippers were essentially treated the same from a rate and service perspective. Rail contracts increased the flexibility in rate-making and services. As a result, individual elevators normally operating through a commission company, could potentially negotiate favorable rates relative to the tariff rate, and potentially relative to competitor elevators. However, rate concessions required commitments normally in terms of shipments. As a result of this, larger elevators, and/or elevators associated with certain commission companies may have been able to improve their financial performance through favorable rail rates.

The second impact of the change in rail legislation was the increased use of unit-train rates. While former regulations did not prohibit use of rail rate contracts, the Staggers Act facilitated their increased use. The advent of unit-train shippers came slow in North Dakota. Elevators were confronted with a wide variety of crops grown and low-production density. As a result, a large supply area was needed to justify the development of elevators with capacity for loading unit trains. Crops such as durum wheat,

HRS wheat, and malting barley were less amenable to unit-train shipment because unlike corn and soybeans they require quality segregation in the marketing system. Unit-train shipping was introduced in North Dakota in July 1980, for westbound rail and July 1981, for eastbound rail.

The use of unit-train rates has the potential for substantial transportation savings. For an elevator to take advantage of unit-train rates, elevators generally have had to increase trackage and throughput capacity. An increase in trackage is needed to have enough room for the unit train to be loaded. Increased throughput capacity is needed due to the time constraint, usually 24 hours, for loading cars. The incentives to develop unit-train loading capabilities exist only as long as cost savings related to multiple-car rates exceed expansion costs.

Unit-Train Shipping and Mergers

One of the important strategic responses of the elevator firms in North Dakota to the developments above was that of mergers of geographically close firms. Increases in mergers may have been attributable to changes in rail legislation. However, more likely, mergers were the result of a number of forces affecting the economics of the country elevator industry. As the competitive environment intensified in the 1980s, firms generally were forced to either become larger and operate as a single plant, or to merge with nearby elevators and operate as a multiple-plant firm.

There are two likely reasons for the recent merger activity within the country elevator industry. Acquiring firms attain economies of transportation, trade area, and size by purchasing or acquiring a nearby competitor. Second, mergers allow smaller country elevators to continue to operate through the opportunity to align facilities to exploit efficiencies normally associated with subterminal elevators (e.g. faster and less costly loading). The most important of these efficiencies is rate savings based on multiple-car and unit-train shipments, and mergers allow an alternative in assembling the required volume of grain.

Through the 1980s, certain areas of the state experienced consolidation of cooperatives and, in some cases, new grain facilities were constructed. Conceptually, new grain facilities (subterminals) are supported by the consolidated elevators which act as satellites or feeder stations. The satellite (multiple plant) system enables the cooperative subterminal to procure sufficient volumes of grain for multiple-car shipments.

To make expansion profitable, the firm must be able to increase throughput. As a result, firms began to adopt unit-train loading to increase throughput. As of January 1987, there were 116 elevators that had the capability of loading unit trains in North Dakota. These elevators are shown in Figure 2. Unit-train shippers are concentrated in the northern and eastern regions of the state where the concentration of production is the greatest. Out of these 116 elevators, 64 are owned by cooperatives. Since there are 573 licensed elevators in North Dakota as of 1987, multiple-car shipping elevators comprise only 20 percent of total licensed elevators.

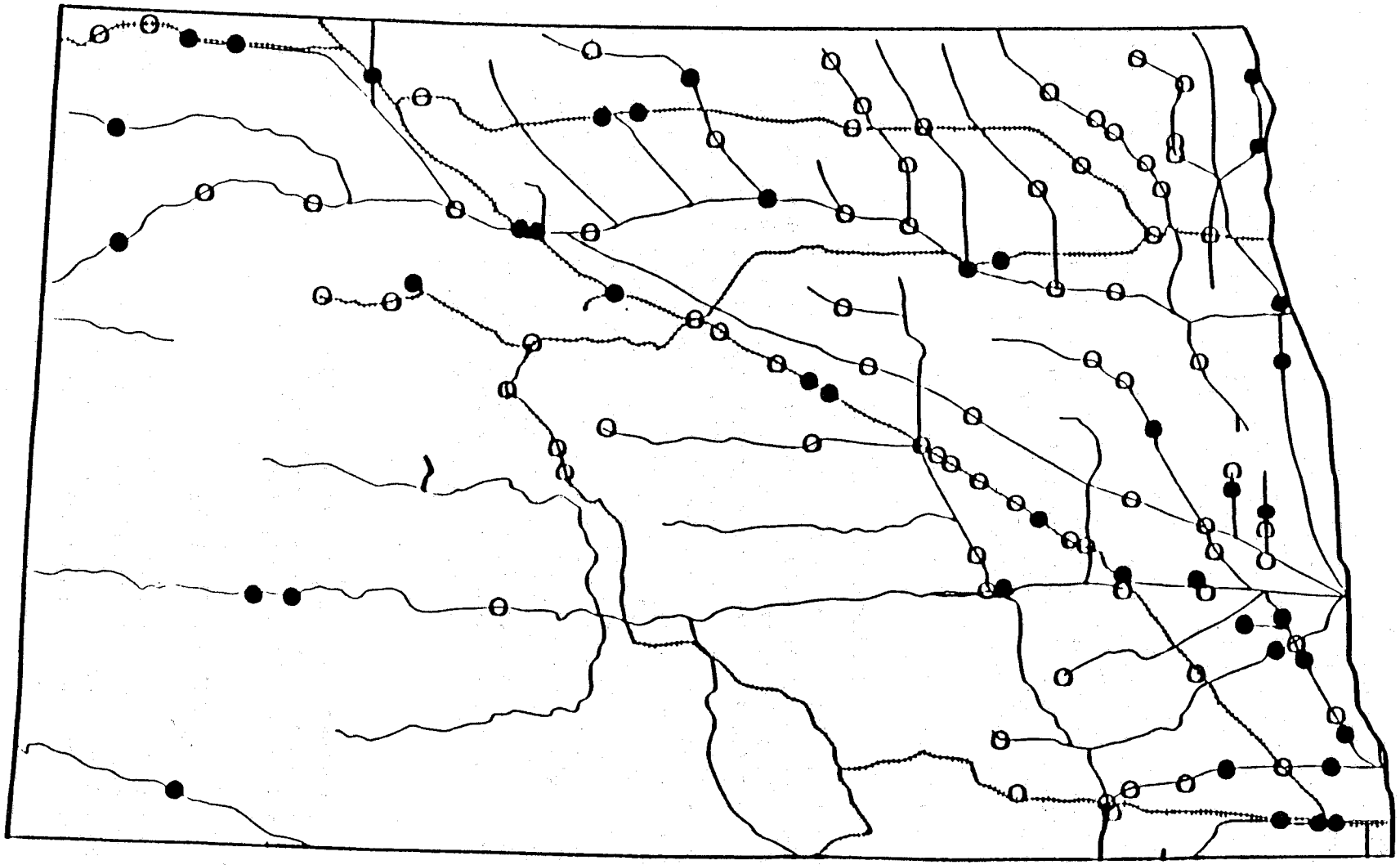


Figure 2. Multiple Car Loading Stations in North Dakota, January 1987

An increase in volume improves plant efficiency by reducing unit costs. The reduction in unit handling costs allows the firm to increase the board prices to patrons while continuing to maintain a certain margin level. However, due to limited supplies of grain in certain regions, margins have been sacrificed to attract a larger throughput volume. As a result, the cost savings from implementation of unit-train loading may be foregone due to paying higher board prices to attract throughput volume which is a direct result of excess loadout capacity in certain regions.

As of 1987, 22 cooperative multiple-plant firms were operating in North Dakota. These firms are presented in Figure 3. The greatest concentration of multiple-plant firms are found in the northern portion of the state. On the other hand, single-plant unit-train shippers were more highly concentrated in the eastern portion of the state where production levels were higher. There may be inefficiencies associated with multiple-plant firms. Most notable would be hauling grain against the market and double handling.

II. Financial Ratio Analysis

Concepts and Definition

Data from firm financial statements are used to analyze the financial and operating performance of individual firms, as well as to identify trends in the industry. The analysis of ratios provides a means of showing the relationship between items in financial statements as well as providing guidelines for evaluation. It is useful to compare the performance of individual firms to industry standards, which are normally taken as the average of ratios from similar firms. In addition, important trends in the industry can be identified by evaluating financial and operating ratios. Each ratio is designed to highlight a particular phase of the financial conditions of a business. It is helpful to transform financial data to each other in order to obtain ratios which express a significant comparison more useful than the raw figures themselves. Financial and operating relationships expressed in terms of ratios have little significance except as they are judged by making comparisons. There are, in general, four categories of financial ratios of importance and each are discussed below.

1) Liquidity

Liquidity provides a measure of the ability of the firm to meet its maturing obligations. The most commonly used liquidity ratio is the current ratio. Current assets normally include cash, marketable securities, accounts

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

receivable, and inventories. Current liabilities consist of accounts payable, short-term notes payable, current maturities of long-term debt, accrued income taxes and other accrued expenses. If current liabilities are rising faster than current assets, the current ratio falls, indicating a developing

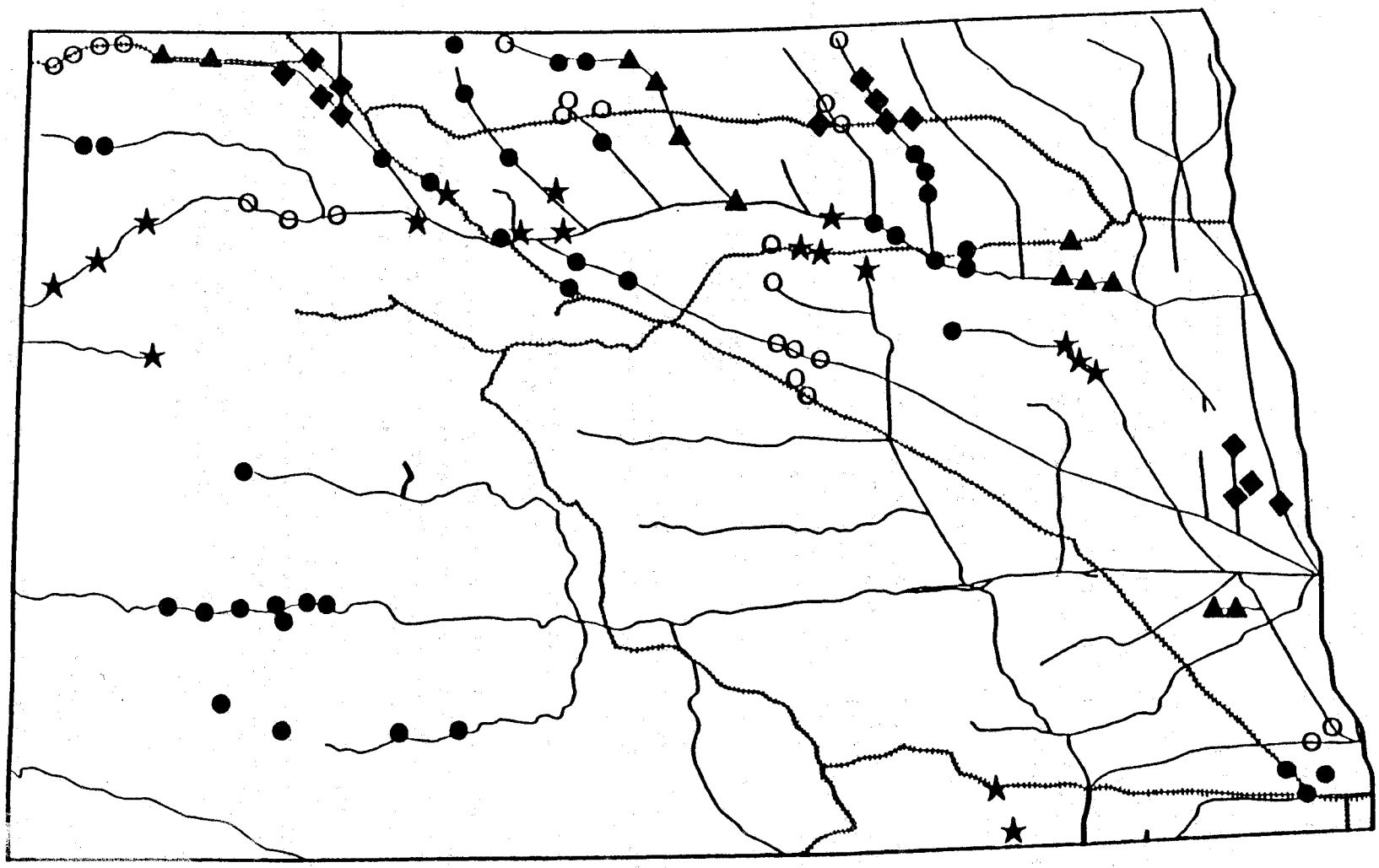


Figure 3. Number and Location of Multiple-Plant Cooperatives in North Dakota, 1987

financial problem. The current ratio provides the best single indicator of the extent to which the claims of short-term creditors are covered by assets that are expected to be converted to cash.

2) Test of Solvency

Test of solvency provides measures of the financial leverage of the firm. Solvency describes the ability of the firm to meet the interest costs and repayment schedules of its long-term obligations (debt). Debt for all practical matters is defined to include current liabilities plus all long-term debt. The following three ratios were selected in testing the solvency of the cooperative elevators:

1. Debt to net worth = $\frac{\text{Total Liabilities}}{\text{Net Worth}}$

A larger ratio indicates less security for the creditor. If the ratio is in excess of one, creditors would have more at stake in the business than the owners. If total liabilities exceed net worth, it is important to determine what amount of the liabilities are long term. Therefore, the following ratio should be used for cooperative elevators:

2. Long-term debt to net worth = $\frac{\text{Long-Term Liabilities}}{\text{Net Worth}}$

If a large proportion of the total liabilities are noncurrent, the amount of security need not be as large as would be required if they were mostly current.

3. Debt to total assets = $\frac{\text{Total Liabilities}}{\text{Total Assets}}$

The ratio of total liabilities to total assets, generally called the debt-to-asset ratio, measures the percentage of total funds provided by creditors. Creditors prefer a low debt ratio, since the lower the ratio, the greater the cushion against creditors' losses in the event of liquidation.

The extent to which firms use financial leverage has three important implications. First, by raising funds through debt, the owners maintain control of the firm with a limited investment. Second, creditors look to the equity to provide a margin of safety; if the owners have provided only a small proportion of total financing, the risks of the enterprise are borne mainly by the creditors; and third, if the firm earns more on borrowed funds than it pays in interest, then the return on the owner's capital is magnified, or leveraged (Brigham).

3) Test of Asset Management

There are a number of ratios to analyze the operating efficiency of a firm. The following ratios are designed to measure how effectively the firm

is managing its assets. In particular, the asset management ratios answer this question: Does the total amount of each type of asset as reported on the balance sheet seem reasonable in view of current and projected operating levels? The following three ratios are used as measures of asset management:

1. Fixed Asset Utilization = $\frac{\text{Sales}}{\text{Net Fixed Assets}}$

The ratio of sales to net fixed assets is called the fixed assets turnover ratio. This is a measurement of utilization of plant and equipment. In this case, sales is defined as the value of total grain and merchandise sales for the year. A measurement of utilization of plant size is storage capacity turnover.

2. Storage Capacity Turnover = $\frac{\text{Total Bushels Handled}}{\text{Storage Capacity}}$

The storage capacity turnover is used to determine the degree to which the grain handling facilities are utilized.

3. Total Asset Utilization = $\frac{\text{Sales}}{\text{Total Asset}}$

Total asset utilization measures the amount of sales to the firm's total assets. Again, sales is defined as the total value of grain and merchandise sales for the year. This measures the amount of sales generated by a given level of total assets.

4) Profitability

The last group of ratios are measures of profitability and are used in this study as measures of performance. Five ratios were selected for consideration in this group.

1. Return on Equity = $\frac{\text{Net Income}}{\text{Net Worth}}$

The return on equity ratio is most commonly used to measure return on investment. It is a fair measure for appraising the earning power of the equity investment.

2. Return on Total Assets = $\frac{\text{Net Income Plus Interest Expense}}{\text{Total Assets}}$

The return on total assets measures the return on total assets taking into account interest expense and indicates the firm's savings for both its long-term and short-term investments. Total assets are the value of all belongings owned by the firms at the end of the accounting year. The original cost of fixed assets has been adjusted by reducing the accumulated depreciation.

Total operating revenue of the cooperative elevators comes from three general sources:

1. Grain sales
2. Input sales
3. Total storage payments

The following three ratios represent the source of operating margins:

1. $\frac{\text{Grain Margin To}}{\text{Total Operating Margin}} = \frac{\text{Grain Margin}}{\text{Total Operating Margin}}$

2. $\frac{\text{Sales Margin To}}{\text{Total Operating Margin}} = \frac{\text{Sales Margin}}{\text{Total Operating Margin}}$

3. $\frac{\text{Total Storage Payments}}{\text{Total Operating Margin}} = \frac{\text{Total Storage Payments}}{\text{Total Operating Margin}}$

It is often recommended that elevators diversify in order to better utilize labor throughout the year and to increase traffic to the elevator. These three ratios measure the level of diversification and can be used as a guide in adjusting the product mix. In the above ratios, Total Operating Margin is defined as total revenue earned by the firm.

Throughout the analysis presented below, comparisons are made between ratios across different classifications. These include firm type, region, before and after 1982, and the impacts of mergers. For each classification, a statistical test was performed to determine if significant differences existed. The statistical procedure used was the Tukey's Studentized Range Test.

There have been a number of similar studies that have analyzed financial ratios of grain elevators in the United States. An extensive study was conducted by Yager and Cummins in 1986 for the USDA Cooperative Extension Service. Yager and Cummins categorized their financial and operating ratio analysis by the volume of grain handled by a cooperative (over 15 million or under 15 million bushels). Other regional studies included a research project conducted by Babb at Purdue University between 1979 to 1983. Ratio analysis was used to compare financial and operating performance between types of ownership (private vs cooperative) of several forms of agribusiness.

Within the grain elevator industry in North Dakota, a number of financial ratio studies have been conducted. In 1924 the first of these studies was conducted by Benton and Peightal. Since 1960 a number of Master theses have used financial ratio analysis to analyze problems facing the elevator industry. In 1962, Velde updated the work that Benton and Peightal had done earlier. In 1966, Anderson analyzed financial audits that were collected from 23 cooperative elevators between 1961 through 1963. Lastly, Rungdanay analyzed financial and operating ratios of Grain Terminal Association (GTA) affiliate elevators. This study was conducted over the period between 1960-70.

Source of Data and Description of Sample

The financial data used in the ratio analysis in this chapter was ascertained from a sample of elevators in North Dakota. The criteria used for selecting the sample of elevators was based upon two requirements: 1) the elevator must be a cooperative and 2) the firm must have had the capability to load unit trains in 1986. In 1986 there were 64 cooperative elevators identified that could load unit trains in North Dakota. From those 64 firms, 58 cooperatives were chosen to be contacted for this study.

The basis for this study is to analyze financial and operating performance of cooperative unit-train shipping elevators in North Dakota. Since the majority of unit-train shippers in North Dakota are cooperatives, the criteria used for selecting the sample of elevators in this study should provide a true measure of performance of this industry.

The process of identification was made possible from data made available from Burlington Northern and Soo Line railways. Once the 58 firms were chosen, a telephone interview was conducted. The firms were given the choice to either provide the financial statement or sign a release form giving permission to contact either their affiliation accounting departments or field men. A cover letter, release form, and survey were sent to 52 firms that agreed during the telephone interview to furnish financial data. In Appendix A a copy of the cover letter, release form, and survey can be found. Out of the 52 firms contacted, 45 firms furnished financial statements from 1978 to 1986. Out of 45 firms, 23 are single plants and 22 were multiple-plant firms.

The financial data collected from the elevators for the most part consists of annual stockholders' reports; however, a few firms provided the annual audit. The following information was collected from the appropriate financial statements: first, from the balance sheet, current, fixed, and total assets were ascertained along with current, long-term, and total liabilities. Net worth was also taken from the capital portion of the balance sheet. Second, from the income statement, total sales, and a breakdown of income by business activity was collected. These activities include grain sales, chemical and fertilizer sales, local and government storage, interest receivable, and miscellaneous sales. Net profit was also taken from the income statement. Third, from the volume statement, both receipts and shipments for HRS, durum, barley, sunflower, and miscellaneous commodities were collected. Miscellaneous commodities included corn, soybeans, flax, oats, and a number of lesser handled crops. Lastly, from the expense statement, salary, insurance, utility, repair, depreciation, interest, and total expense figures were gathered. Transformation was required to derive certain measurements, as in the case of calculating percentage of revenue earned from business activities which required the summation of grain margin, input sale margin (chemical and fertilizer), interest income, local and government storage and miscellaneous income.

Financial and Operating Ratios

Presentation of results is organized as follows. First, results are presented comparing single- and multiple-plant firms. The second section makes a comparison by region. Comparisons are then made before and after 1982, and before and after mergers for selected firms. In each section, the analysis focuses on the means of the selected ratios and their differences by classification. Also, coefficients of variation are presented for each ratio. The coefficient of variation is defined as the standard deviation of the ratio divided by the mean, times 100 and is used to describe the amount of variability in the sample. The selected financial ratios to be used in this analysis are presented in Table 6. Individual composite ratios are presented on a yearly basis from 1978 to 1986 in the Appendix.

Single- and Multiple-Plant Firms

The cooperative elevators were classified into two groups: 1) single plant and 2) multiple plant. In Table 7 the means of the selected ratios are presented. The current ratio is significantly different between single- and multiple-plant firms. For every $1.00 worth of current debt, single-plant firms have $1.32 worth of current assets as compared to $1.23 for multiple-plant firms. Therefore, single-plant firms are better able to meet current obligations. Solvency is measured in terms of debt-to-asset, debt-to-equity, and long-term-debt ratios. In all three cases there was no

TABLE 6. SELECTED RATIOS AND THEIR USES

Ratio Use	Selected Ratio
Test of liquidity	Current ratio
Test of solvency	Debt to equity Debt to total asset Long-term debt to equity
Tests of asset Management	Storage capacity turnover Fixed asset utilization Total asset utilization
Tests of profitability	Return on equity Percent grain revenue to total revenue Percent storage revenue to total revenue Percent sales revenue to total revenue

TABLE 7. MEANS OF SELECTED FINANCIAL RATIOS OF COOPERATIVE ELEVATORS CLASSIFIED BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Selected Ratio	Firm Type	
	Single Plant	Multiple Plant
Liquidity		
Current ratio	1.32**	1.23
Solvency		
Debt/asset ratio	.52	.53
Debt/equity ratio	.38	.36
Long-term debt ratio	.16	.21
Asset management		
Storage capacity turnover	4.68**	3.87
Fixed asset utilization	15.21**	9.71
Total asset utilization	3.35**	2.48
Profitability		
Return on assets	.05	.04
Return on equity	.11	.09
Percent grain income	.53	.54
Percent storage income	.17	.16
Percent sales income	.13**	.11

**Significant difference from multiple plants at the 5 percent level.

significant difference by firm type. This indicates that the level of debt is the same for both single- and multiple-plant firms over this time period.

Single-plant elevators have a distinct advantage over multiple-plant firms in the area of asset management. First, the average storage capacity turnover ratio for single-plant firms is 4.68, as compared to 3.87 for multiple-plant firms. This means if a single-plant elevator with 100,000 bushel storage capacity would move an average 468,000 bushels as compared to 387,000 bushels for a multiple plant. However, an important distinction should be made between types of firms. For most multiple-plant firms, large storage capacities are the result of a number of physical plants located in different geographic regions.

For both fixed asset and total asset utilization ratios, performance of single-plant firms was superior. The single-plant firm has sales of 15.2 times the amount of the value of fixed assets whereas multiple-plant firms have total sales volume of only 9.71 times the value of fixed assets. Again, this may be explained in the context of physical plant size and age of the firm.

There was no significant difference between firm types for rate of return on assets or return on equity. The percent of grain revenue to total revenue, along with percent of storage revenue to total revenue, were not significantly different by firm type. This suggests that over the same time period, revenue earned by single- and multiple-plant firms were in the same proportion. The percent of sales income to total revenue differs between single- and multiple-plant firms. The single-plant firm earns 13 percent of their total revenue from sales income as compared to 11 percent for multiple-plant firms.

In Table 8 the rate of return on equity is presented along with net profit and net worth by firm types for the years 1978 through 1986. For both firm types net worth has increased dramatically over time, which may explain the lower rate of return on equity in recent years. Net profit for each type of firm has been sporadic but increased to record levels in 1986. Of particular interest also is that return on equity has generally been declining since 1980 (Figure 4). However, return on equity for each firm type increased in 1986, but proportionately and absolutely more for single-plant firms.

Means, coefficients of variation, and ranges of each selected ratio are presented for both single-and multiple-plant firms, respectively (Table 9). For the most part, selected ratios representing single-plant firms have a greater variation in relative terms than those for multiple-plant firms. The only exception is the long-term debt-to-equity ratio which has greater variability across multiple-plant firms compared to that of single-plant firms. However, in both cases long-term debt is extremely variable across firms in the sample.

TABLE 8. MEAN OF NET PROFIT AND NET WORTH OF COOPERATIVE ELEVATORS CLASSIFIED BY FIRM TYPE, NORTH DAKOTA, 1978-1986

	Single Plant				Multiple Plant			
Year	Net Profit	Net Worth	Return on Equity	N	Net Profit	Net Worth	Return on Equity	N
1978	101,007	737,063	.11	25	171,044	1,570,259	.12	15
1979	164,434	834,380	.16	25	318,663	1,820,986	.18	15
1980	171,994	888,413	.19	25	346,498	1,962,070	.18	16
1981	126,465	956,918	.11	25	249,506	2,252,668	.12	18
1982	68,961	946,783	.05	24	111,790	2,507,410	.04	19
1983	103,048	1,020,046	.09	23	273,581	2,837,397	.09	20
1984	88,360	1,050,048	.07	22	132,49	2,878,013	.03	23
1985	92,032	1,095,350	.08	22	212,192	3,041,600	.05	23
1986	188,732	1,123,181	.15	15	323,032	3,194,242	.08	21

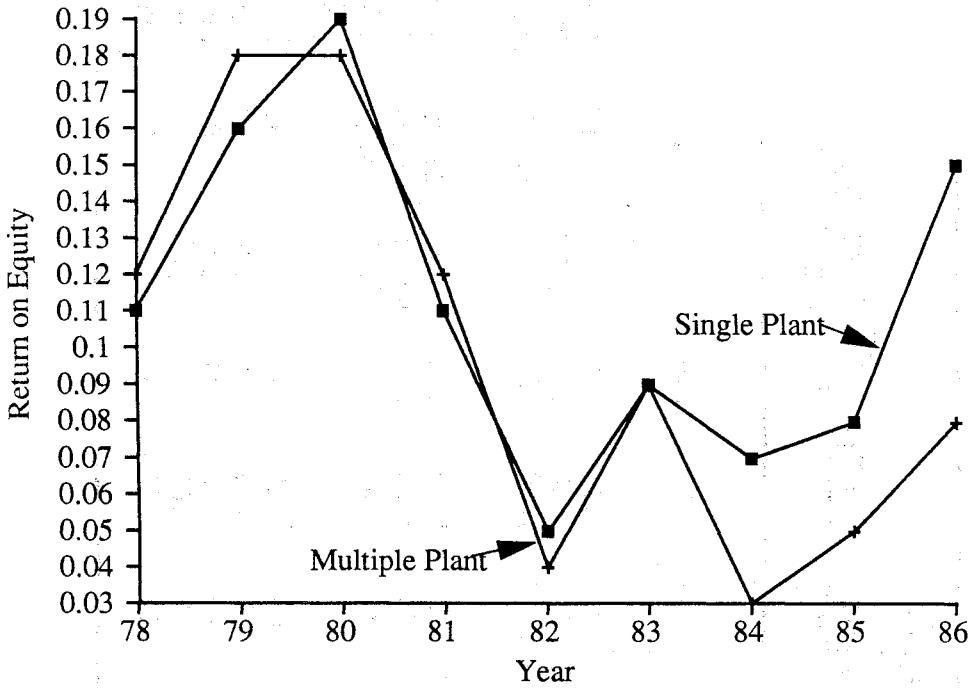


Figure 4. Return on Equity for Single- and Multiple-Plant Firms, 1978-1986

Financial and Operating Performance by Region

In this section, both single- and multiple-plant firms are pooled and classified by geographic location within the state. The state has been broken into two regions, east and west. The western region is comprised of the Crop Reporting Districts (CRD) 1, 2, 4 and 7, and the remaining CRD's are reported as the eastern region.

Solvency of the firm was observed to be significantly different between the eastern and western regions of North Dakota as shown in Table 10. The debt-to-asset and debt-to-equity ratios were greater in the western region. However, long-term debt-to-equity ratio was less in the western region (.14) compared to (.21) in the eastern reigon. This can be interpreted that for every $1.00 of equity in the western region, $0.14 worth of long-term debt exists compared to $0.21 for eastern North Dakota. Therefore, elevators in the western region have a greater debt load but the majority of this debt is financed in the short term.

TABLE 9. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF SINGLE- AND MULTIPLE-PLANT COOPERATIVE ELEVATORS, NORTH DAKOTA, 1978-1986

Selected Ratio	Mean		Coefficient of Variation		Range				Observations	
					Minimum		Maximum			
	S	M	S	M	S	M	S	M	S	M
Liquidity										
Current ratio	1.32	1.23	25	23	.62	.14	2.55	2.74	206	171
Solvency										
Debt/asset ratio	.53	.53	28	26	.18	.22	.87	.85	206	171
Debt/equity ratio	1.38	1.36	67	57	.22	.28	6.80	4.01	206	171
Long-term debt ratio	.16	.21	125	157	.00	.00	.93	2.12	206	171
Asset Management										
Storage capacity turnover	4.42	3.87	48	53	1.09	.75	14.45	12.89	197	169
Fixed asset utilization	15.21	9.71	65	50	3.74	3.25	59.71	39.99	163	158
Total asset utilization	3.35	2.48	44	30	1.01	.93	9.10	6.07	163	158
Profitability										
Return on equity	.11	.09	100	100	-.25	-.36	.43	.31	206	170
Return on assets	.07	.06	71	66	-.09	-.04	.30	.17	206	170
Percent grain income	.53	.54	32	25	.10	.24	.91	.88	206	170
Percent storage income	.17	.16	58	56	.00	.02	.66	.53	206	170
Percent sales income	.13	.11	84	81	.04	.00	.48	.33	190	169

S = Single Plant
M = Multiple Plant

TABLE 10. MEANS OF SELECTED FINANCIAL RATIOS OF COOPERATIVE ELEVATORS CLASSIFIED BY REGION, NORTH DAKOTA, 1978-1986.

Selected Ratio	Region	
	West	East
Liquidity		
Current ratio	1.25	1.30
Solvency		
Debt/asset ratio	.56	.51**
Debt/equity ratio	1.50	1.28**
Long-term debt ratio	.14	.21**
Asset Management		
Storage capacity turnover	4.65	3.87**
Fixed asset utilization	13.97	11.40**
Total asset utilization	2.63	3.14**
Profitability		
Return on assets	.05	.07**
Return on equity	.10	.11
Percent grain income	.56	.52**
Percent storage income	.16	.17
Percent sales income	.09	.14**

**Significant difference from Western Region at the 5 percent level.

Firms in the western region were observed to have a greater storage capacity turnover ratio as compared to firms in the eastern portion of the state. Grain shipments in the west averaged 4.65 times the storage capacity compared to 3.87 times for firms in the eastern region. Since firms in the western region move more grain in comparison to the storage capacity, these firms achieve a greater fixed asset utilization of 13.97 in comparison to 11.40 for their eastern counterparts. Elevators located in the eastern region were better able to utilize their total asset (3.14) compared to firms in the western portion of the state (2.63).

Average rate-of-return on assets was greater for firms in the eastern region, at 7 percent, compared to a 5 percent return on assets for western firms. Again, the issue of asset reserves may cause this distortion. Rate-of-return on equity however, was nearly the same at 10 and 11 percent for the western and eastern region, respectively.

The percent of grain revenue to total revenue was statistically different between western and eastern regions. It was found that 56 percent of the total revenue was earned from grain operation for western firms compared to 52 percent for eastern firms. It was also observed that firms

located in the eastern portion of the state earned 14 percent of the total revenue from the sale of chemical and fertilizers compared to 9 percent in the western region. Since both regions have nearly the same percent of storage revenue to total revenue, it could be concluded that firms located in western regions are more likely to be in business to move grain as compared to providing services.

In Table 11, means, coefficients of variation, and ranges are presented for selected ratios for eastern and western regions, respectively. The coefficient of variation is relatively close for most ratios analyzed by region. However, the exception was long-term debt-to-equity. In this case, long-term debt-to-equity was more variable for western firms at 178.45 as compared to 131.18 for firms located in the eastern region.

In general, firms located in the western region made better utilization of their physical plants and were observed to have a different debt structure as compared to firms located in eastern North Dakota. It was also observed that firms located in the western region earn more of their total revenue from grain sales and less from input sales, therefore, indicating that these firms may be more vulnerable to farm programs that affect the level of grain shipments.

Financial and Operating Performance Before and After 1982

There have been distinct changes in several features of the competitive environment in the 1980s versus the 1970s. These include changes in the railroad legislation in 1980, affecting both rate contracting and unit-train shipping, the full effects of which were not realized until several years later. In addition, significant changes in the farm programs have affected production and shipments, as well as the storage market. In this section, comparisons are made in the financial and operating performance before and after 1982. Differences which do exist cannot necessarily be attributed to any of these changes individually, but are due to the combined effects of the competitive environment.

Both single- and multiple-plant firms are pooled and classified into two time periods, 1978-1981 and 1982-1986. Prior to 1982 there had been limited adoption of unit trainloading facilities. The frequency of unit-train adoption is shown by year in Figure 5. Adoption of unit-train shipping capabilities ranged from 6-12 firms per year in the period 1982-1985.

Comparison of financial and operating ratios before and after 1982 are made in Table 12 for single-plant and multiple-plant firms. Ratios representing both liquidity and solvency remained relatively unchanged before and after 1982 for single-plant firms. However, for multiple-plant firms, a noticeable difference was observed. Prior to 1982, multiple-plant firms had $1.30 worth of current assets to cover $1.00 worth of current liabilities. After 1982, only $1.20 worth of current assets remained. It was also observed the solvency of multiple-plant firms changed but not significantly. Long-term debt-to-equity increased from .16 before 1982 to .23 after 1982. For every $1.00 worth of equity, $0.16 worth of long-term debt before 1982 to $0.23

TABLE 11. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF COOPERATIVE ELEVATORS, EASTERN AND WESTERN REGION, NORTH DAKOTA, 1978-1986

Selected Ratio	Mean		Coefficient of Variation		Range				Observations	
					Minimum		Maximum			
	E	W	E	W	E	W	E	W	E	W
Liquidity										
Current ratio	1.30	1.25	26	22	.14	.55	2.55	2.75	228	149
Solvency										
Debt/asset ratio	.51	.56	29	25	.18	.22	.87	.85	228	149
Debt/equity ratio	1.28	1.50	68	55	.22	.28	6.80	4.11	228	149
Long-term debt ratio	.21	.14	131	178	.00	.00	2.13	1.69	228	149
Asset Management										
Storage capacity turnover	3.87	4.65	52	48	.75	1.56	14.45	12.89	227	139
Fixed asset utilization	11.40	13.97	68	64	3.53	3.25	59.71	52.42	184	137
Total asset utilization	3.14	2.63	43	41	1.01	.93	9.10	8.35	184	137
Profitability										
Return on equity	.11	.10	104	96	-.36	-.26	.43	.31	228	148
Return on assets	.07	.05	63	72	-.07	-.09	.30	.17	228	148
Percent grain income	.52	.56	30	28	.16	-.10	.91	.82	228	148
Percent storage income	.17	.16	58	60	.00	.02	.46	.66	228	147
Percent sales income	.14	.09	72	101	-.04	.00	.48	.47	218	141

E = Eastern
W = Western

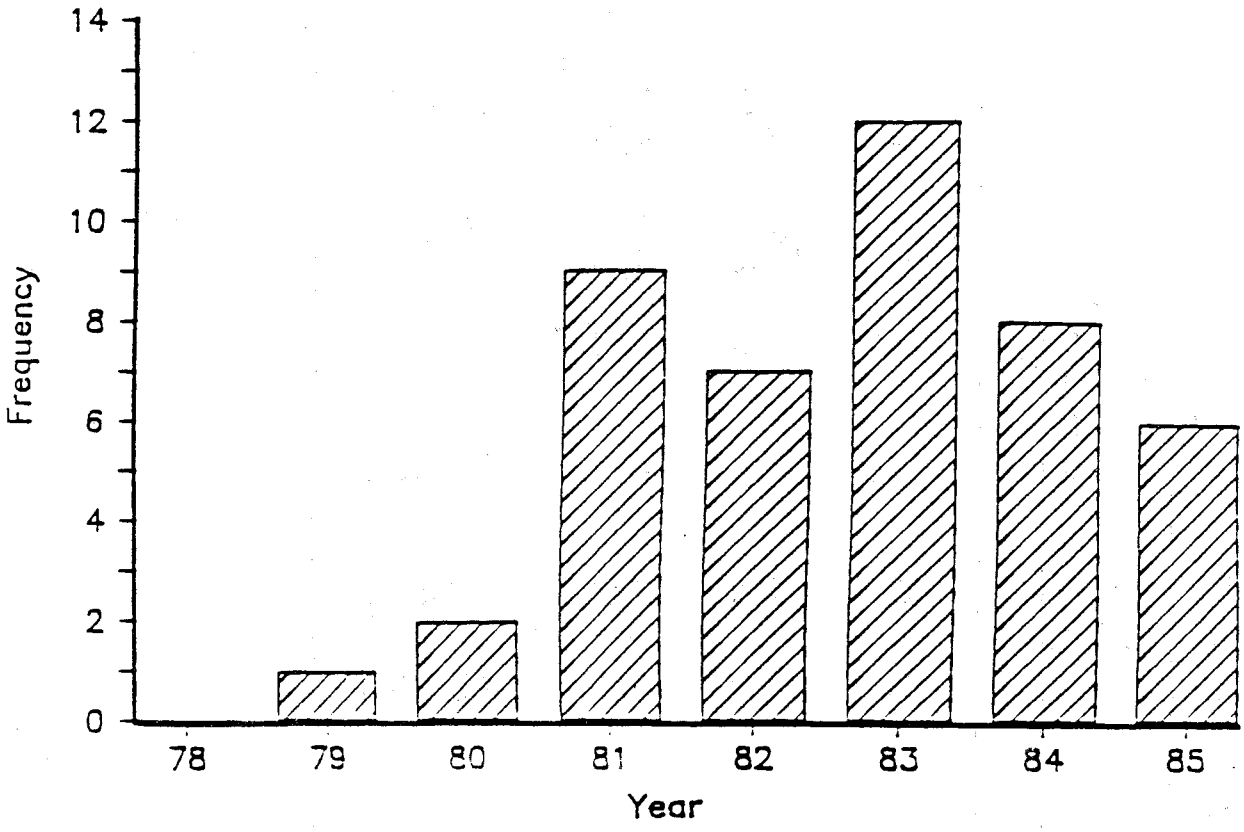


Figure 5. Frequency Distribution by Year of Adoption of Unit-Train Loading

afterwards. As a result of plant and equipment improvement to load unit-trains, combined in certain cases with financing mergers, multiple-plant firms increased their level of long-term borrowing to adapt to the changing industry environment.

Storage capacity turnover declined after 1982 for single-plant firms. Prior to 1982, single-plant firms were capable of shipping 4.75 times their storage capacity which has declined to 4.13 times. A major contributing factor to this decline has been the expansion of physical plant size. Even if the firm handles more grain, if the plant size increases more, the storage capacity turnover ratio will decline.

The degree of asset utilization has declined in the period after 1981. For both single- and multiple-plant firms, fixed asset utilization has declined from 17.42 to 13.07 and 11.91 to 8.40, respectively. This in part is due to the expansion of physical plant assets and factors contributing to farm program impacts. For most firms the adoption of unit-train loading was a competitive strategy of the firm, so they could continue to provide the

TABLE 12. MEANS OF SELECTED FINANCIAL RATIOS OF SINGLE-PLANT COOPERATIVE ELEVATORS, BEFORE AND AFTER 1982, NORTH DAKOTA, 1978-1986

Selected Ratio	Before 1978-1981		After 1982-1986	
	S	M	S	M
Liquidity				
Current ratio	1.33	1.30	1.31	1.20**
Solvency				
Debt/asset ratio	.53	.52	.53	.54
Debt/equity ratio	1.39	1.25	1.38	1.42
Long-term debt ratio	.17	.16	.16	.23
Asset Management				
Storage capacity turnover	4.75	4.12	4.13**	3.72
Fixed asset utilization	17.42	11.91	13.07**	8.40**
Total asset utilization	3.47	2.45	3.24	2.49
Profitability				
Return on assets	.08	.08	.05**	.04**
Return on equity	.14	.15	.08**	.06**
Percent grain income	.59	.61	.47**	.50**
Percent storage income	.11	.09	.22**	.21**
Percent sales income	.15	.10	.12	.11

S = Single plant
M = Multiple plant
**Significant difference between firm type and before and after 1986 at the 5 percent level.

services to patrons. To provide these services, most firms were required to expand trackage and storage capabilities at a significant cost. As other elevators expanded shipping capacity, the fixed asset utilization ratio decreased. The change in the fixed asset utilization ratio reflects the competitive pressures that existed after 1981, along with cost of expansion to adopt unit-train loading.

The rate-of-return on equity has declined from 14 percent before 1982 to 8 percent afterwards for single-plant firms. For multiple-plant firms, rate-of-return on equity declined from 15 percent prior to 6 percent after 1982. There are a number of reasons contributing to this decline: poor export climate of the 1980s, a depressed farm economy, government farm programs (loan and storage programs), change in business atmosphere (reduced inflation), and increased competition resulting from the introduction of unit-train rail rates in 1981. Since the majority of the firms adopted unit-train loading between 1982-1985, any number of the above factors may explain the reasons for lower return on equity.

The percent of grain revenue and percent of storage revenue to total revenue for both single and multiple plants were observed to be statistically different before and after 1982. Since 1982, the percent of grain revenue has declined from 59 to 47 percent for single-plant and 61 to 50 percent for multiple-plant firms. Also during this same time, percent of storage revenue to total revenue increased from 11 to 22 percent for single-plant and from 9 to 21 percent for multiple-plant firms. Since 1983, grain shipments have been declining which resulted in greater competition for existing stocks. As a result, margins may have been sacrificed to attract grain volume. Since not all firms have the same cost structure, percent of grain revenue to total revenue may have declined as a result. However, during this period, government farm program grain was being stored which increased storage revenue to elevators that choose to expand their storage capacity.

In Table 13 and Table 14, means, coefficients of variation, and ranges are presented for selected ratios for single- and multiple-plant firms. Return on equity was more variable for both single- and multiple-plant firms after 1982. For single-plant firms the coefficient of variation for return on equity increased from 81.82 to 118.38 after 1982 where for multiple-plant firms it increased from 48.75 to 155.23. Frequency distributions for rate-of-return on equity are presented for before and after introduction of unit-train rail rates in Figures 6 and 7 for single-plant and Figures 8 and 9 for multiple-plant firms. The number of observations related to each level of return on equity are present. In general, the financial and operating performance of the firms has declined in the period after 1981. Specifically, the percent of grain revenue and storage revenue to total revenue have radically changed after 1982 which is reflective of the external factors influencing the elevator industry in this period.

Financial and Operating Performance Before and After Mergers

In this section, financial and operating ratios are presented for firms that merged between 1980-1986. There were 9 cooperatives identified out of the total 45 firms in the sample which merged during the 1980-1986 period (Table 16). The findings of the selected ratios are presented in Table 15 along with frequency of mergers in Figure 10.

The current ratio declined from 1.47 before the merger as compared to 1.21 after merging. The reason for the reduction may be firms that have merged are using liquid current assets to service long-term debt. As shown by the long-term debt-to-equity ratio, firms that have merged have relied more heavily on long-term debt. Long-term debt-to-equity ratio increased from 16 percent to 32 percent. The cost of leveraging is represented by the level of interest expense; and to service this debt, firms experienced a lowering in their liquidity.

The level of storage capacity turnover has declined. Prior to merging, the turnover ratio was 3.86 which declined to 3.21 after the merger. The reduction of the turnover ratio is the direct result of increasing the storage capacity of the firm. The firm may increase the total volume of bushels handled; however, the increase in volume may not offset the increase in storage capacity which would lower the turnover ratio. For most multiple-

TABLE 13. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF SINGLE- AND MULTIPLE-PLANT COOPERATIVE ELEVATORS, NORTH DAKOTA, 1978-1981

Selected Ratio	Mean		Coefficient of Variation		Range				Observations	
					Minimum		Maximum			
	S	M	S	M	S	M	S	M	S	M
Liquidity										
Current ratio	1.33	1.30	22	29	.93	.14	2.55	2.75	100	64
Solvency										
Debt/asset ratio	.53	.52	28	26	.18	.22	.83	.85	100	64
Debt/equity ratio	1.39	1.25	64	57	.22	.28	4.77	4.01	100	64
Long-term debt ratio	.17	.16	127	186	.00	.00	.93	1.69	100	64
Asset Management										
Storage capacity turnover	4.75	4.12	46	41	1.35	1.10	14.45	9.87	94	63
Fixed asset utilization	17.42	11.91	62	51	4.98	3.30	59.71	39.99	80	59
Total asset utilization	3.47	2.45	41	22	1.72	1.59	9.10	3.97	80	59
Profitability										
Return on assets	.08	.08	61	39	-.03	-.01	.30	.15	100	64
Return on equity	.14	.15	82	49	-.25	-.06	.43	.31	100	64
Percent storage income	.11	.09	81	56	.00	.02	.66	.22	100	64
Percent grain income	.59	.61	30	23	-.10	.28	.91	.88	99	64
Percent sales income	.15	.10	80	90	-.01	.00	.48	.33	90	63

S = Single Plant
M = Multiple Plant

TABLE 14. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF SINGLE- AND MULTIPLE-PLANT COOPERATIVE ELEVATORS, NORTH DAKOTA, 1982-1986

Selected Ratio	Mean		Coefficient of Variation		Range				Observations	
					Minimum		Maximum			
	S	M	S	M	S	M	S	M	S	M
Liquidity										
Current ratio	1.31	1.20	28	19	.63	.55	2.43	2.30	106	107
Solvency										
Debt/asset ratio	.53	.54	29	26	.19	.23	.87	.79	106	107
Debt/equity ratio	1.38	1.42	71	57	.23	.29	6.80	3.81	106	107
Long-term debt ratio	.16	.23	114	151	.00	.00	.76	2.13	106	107
Asset Management										
Storage capacity turnover	4.13	3.72	50	61	1.09	.75	11.09	12.89	103	106
Fixed asset utilization	13.07	8.40	66	42	3.74	3.25	52.42	24.99	83	99
Total asset utilization	3.24	2.49	48	35	1.01	.93	8.35	6.07	83	99
Profitability										
Return on assets	.05	.04	75	73	-.09	-.04	.14	.17	106	106
Return on equity	.08	.06	118	155	-.24	-.36	.30	.28	106	106
Percent storage income	.22	.21	39	38	.06	.04	.46	.53	106	106
Percent grain income	.47	.50	31	25	.16	.24	.76	.82	106	106
Percent sales income	.12	.11	80	80	-.04	.00	.35	.31	100	106

S = Single Plant
M = Multiple Plant

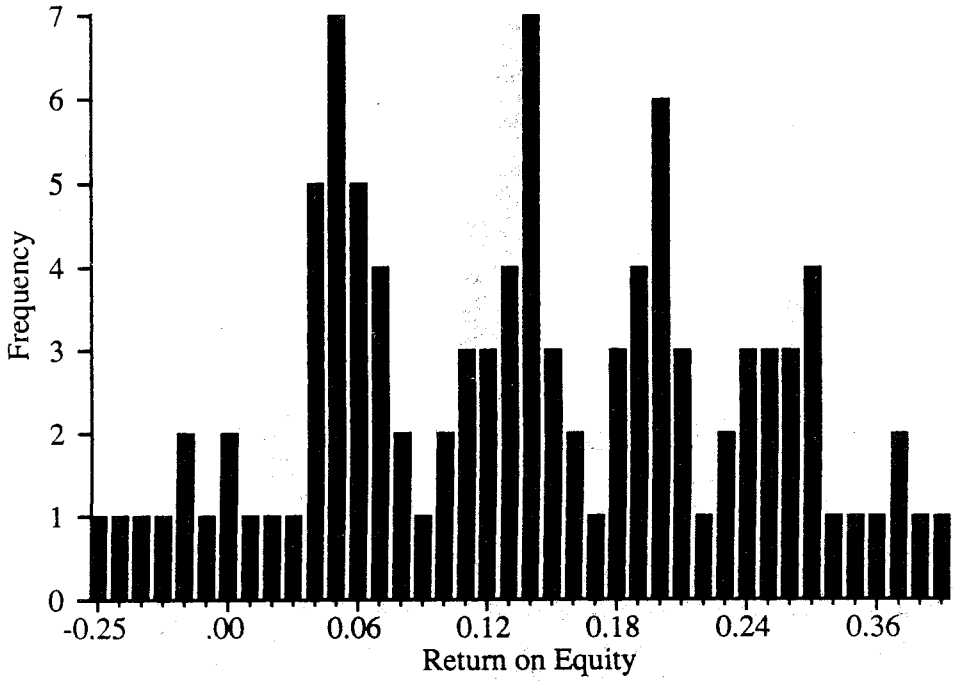


Figure 6. Return on Equity for Single Plant Firms Before 1982

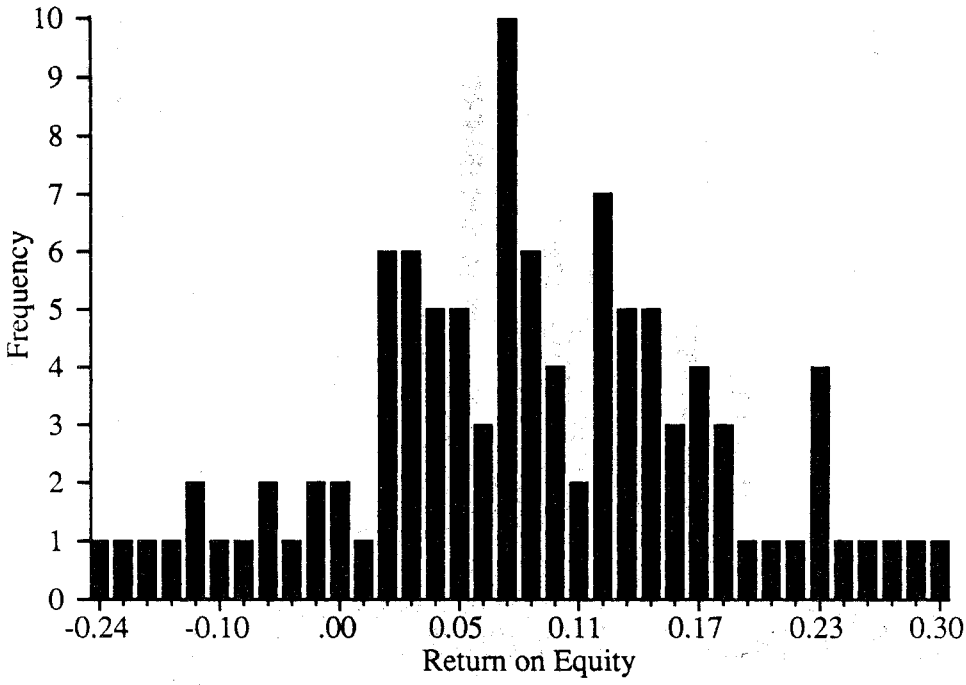


Figure 7. Return on Equity for Single Plant Firms After 1982

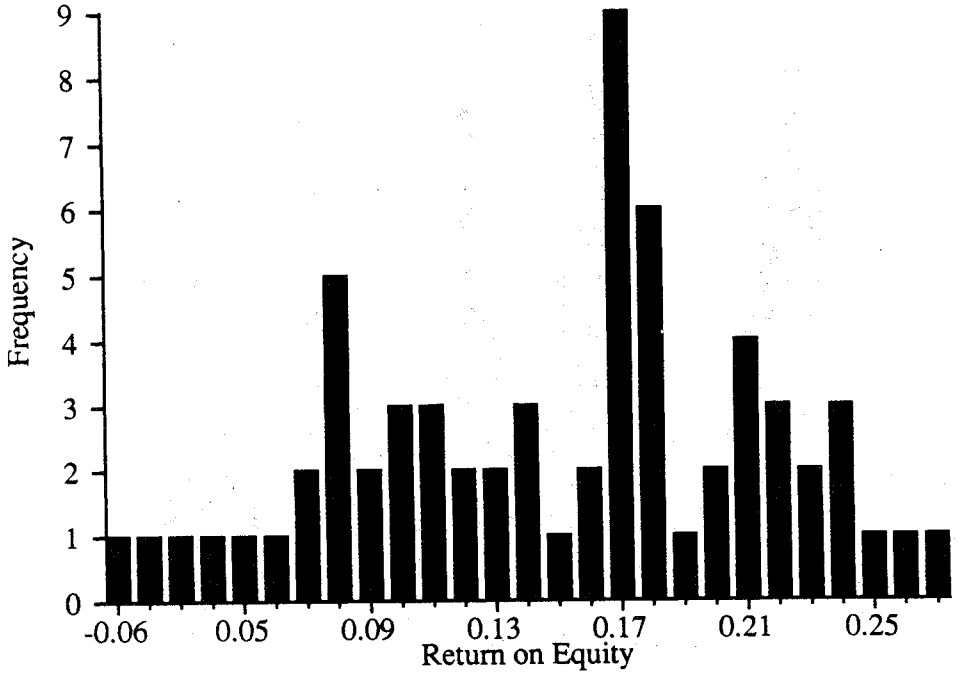


Figure 8. Return on Equity for Multiple Plant Firms Before 1982

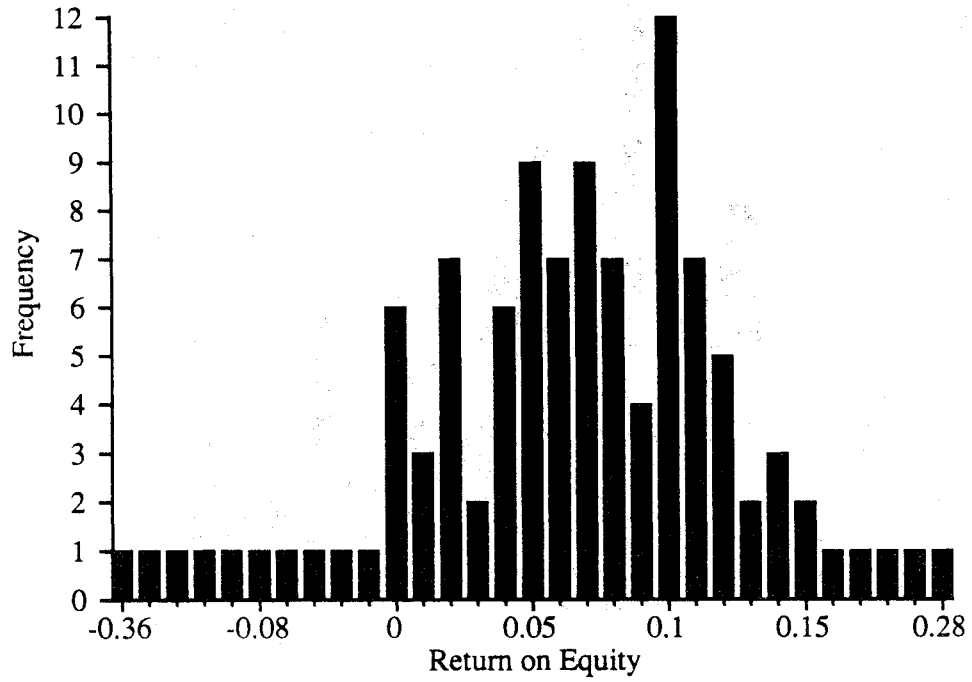


Figure 9. Return on Equity for Multiple Plant Firms After 1982

TABLE 15. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF COOPERATIVE ELEVATORS, BEFORE MERGER, NORTH DAKOTA, 1978-1986

Selected Ratio	Mean	Coefficient of Variation	Range	
			Minimum	Maximum
Liquidity				
Current ratio	1.47	31.29	.93	2.75
Solvency				
Debt/asset ratio	.43	34.88	.18	.72
Debt/equity ratio	.91	70.33	.22	2.59
Long-term debt ratio	.16	225.00	.00	1.68
Asset Management				
Storage capacity turnover	3.86	31.35	1.50	6.22
Fixed asset utilization	11.77	55.65	3.30	38.23
Total asset utilization	2.46	30.89	1.72	5.35
Profitability				
Return on equity	.12	58.33	-.04	.25
Return on assets	.08	50.00	.02	.17
Percent grain income	.69	11.59	.54	.81
Percent storage income	.08	50.00	.03	.18
Percent sales income	.05	100.00	.00	.19

plant firms, turnover ratio can measure the degree of excess plant capacity that may exist. The higher the turnover ratio, the better utilized is the physical plant structure.

Fixed asset utilization represents the number of times the sales revenue is turned over compared to the value of fixed assets. The firms had a higher fixed asset utilization (11.77 times) prior to merging than when compared to after the merger (7.44 times). Again, the fixed asset utilization indicates that firms are not as efficient after mergers. This again suggests that merged firms may have a high degree of excess capacity.

The profitability of the firm as measured by the rate of return on equity declined dramatically after firms merged. Before merging, these firms averaged 12 percent return on equity as compared to 4 percent after merging. This suggests that at least one of the firms that are seeking to merge may be experiencing financial difficulty. As a result of a merger, the newly formed firm may be burdened with a higher than normal debt load, which results in a lower return on equity. The percent of grain revenue to total revenue declined from 69 percent to 57 percent. However, the percent of storage revenue to total revenue has increased from 8 percent to 18 percent.

TABLE 16. MEANS, COEFFICIENTS OF VARIATION, AND RANGES OF SELECTED FINANCIAL RATIOS OF COOPERATIVE ELEVATORS, AFTER MERGER, NORTH DAKOTA 1978-1986

Selected Ratio	Mean	Coefficient of Variation	Range	
			Minimum	Maximum
Liquidity				
Current ratio	1.21	22.50	.55	2.20
Solvency				
Debt/asset ratio	.51	33.33	.26	.77
Debt/equity ratio	1.36	70.59	.35	3.43
Long-term debt ratio	.33	148.48	.00	2.13
Asset management				
Storage capacity turnover	3.77	53.85	1.45	9.74
Fixed asset utilization	7.83	38.95	3.58	14.88
Total asset utilization	2.49	25.70	1.45	4.55
Profitability				
Return on equity	.05	240.00	-.36	.28
Return on assets	.05	80.00	-.02	.17
Percent grain income	.54	22.22	.28	.69
Percent storage income	.20	45.00	.06	.53
Percent sales income	.07	85.71	.00	.24

N = Observation.

As stated in a previous section, the lower percent of grain revenue may be the result of government farm programs and not directly caused by mergers.

In Tables 15 and 16, means, coefficients of variation, and ranges of selected ratios are presented by before and after mergers, respectively. Return on equity is particularly more variable between before merger (58.33) to after merger (240.00). In Figures 11 and 12, a frequency distribution of return on equity is presented for before and after mergers. The frequency distribution indicates that the maximum return on equity before and after mergers were similar, but the minimum is substantially lower after mergers. This strongly suggests that firms were more financially stable before they merged than afterwards.

Long-term debt-to-equity ratio was less variable (225.00) before mergers compared to (148.48) afterwards. One reason for this would be more firms using long-term debt financing to finance the merger. Therefore, most all firms would have some level of long-term debt, which would lower the long-term debt-to equity ratio. Lastly, percent of grain revenue was more

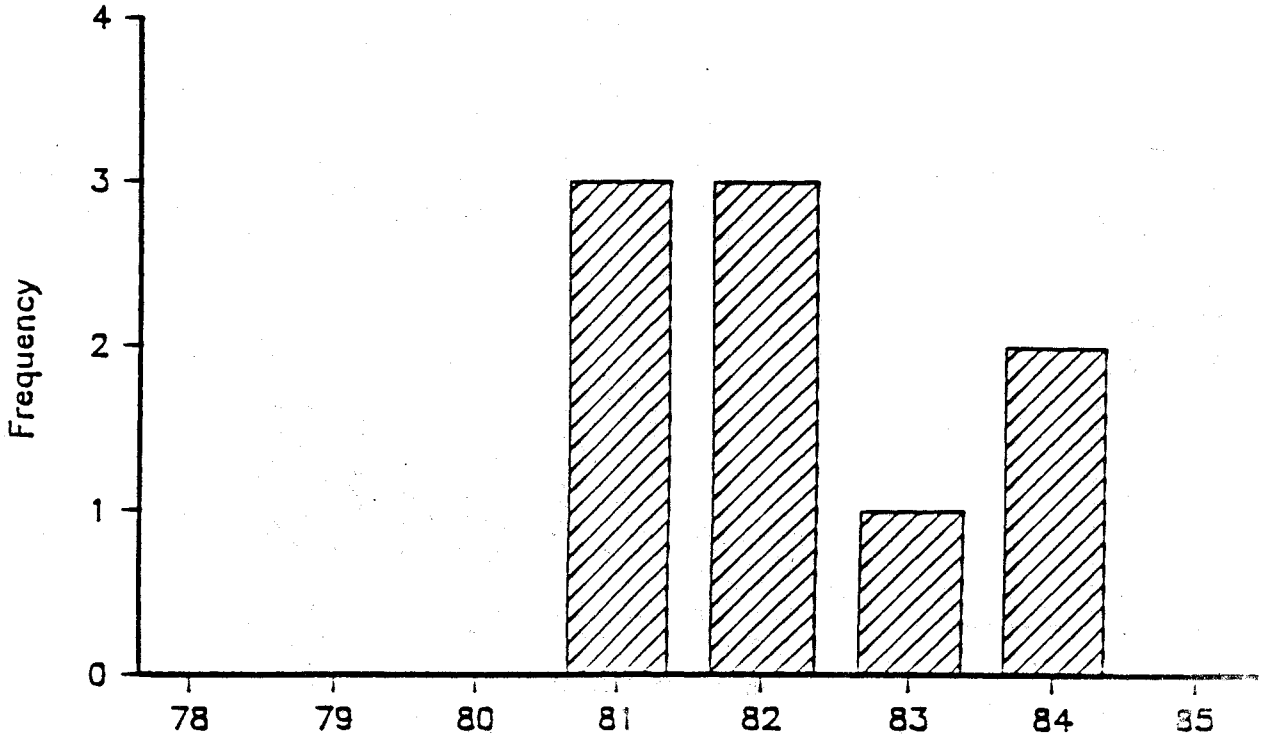


Figure 10. Mergers of Select Elevators Between 1978 to 1985

variable represented by a coefficient of variation of 11.59 for before mergers compared to 22.22 afterwards. This would support findings of why return of equity has been more volatile after mergers.

Overall, financial and operating performance declined after mergers in the group of firms in this study. Return on equity declined from 12 percent prior to the merger as compared to 5 percent after the merger. Another factor included an increase in the level of long-term debt-to-equity ratio from 16 percent to 32 percent. This rise may indicate that firms that have merged are using long-term debt to finance the venture and may be suffering from large interest expense obligations. In conclusion, firms that have merged are experiencing lower returns to equity. Given the time frame of this study, these lower returns to equity should be viewed tentatively since many other factors have changed.

Analysis of Financial Ratio Data

The financial ratios presented above were analyzed to determine the statistical relationship between critical variables. First, simple correlations between ratios are presented, followed by single and multiple regression results used to explain factors affecting variability in return on equity. The correlation matrix between the ratios is presented in Table 17.

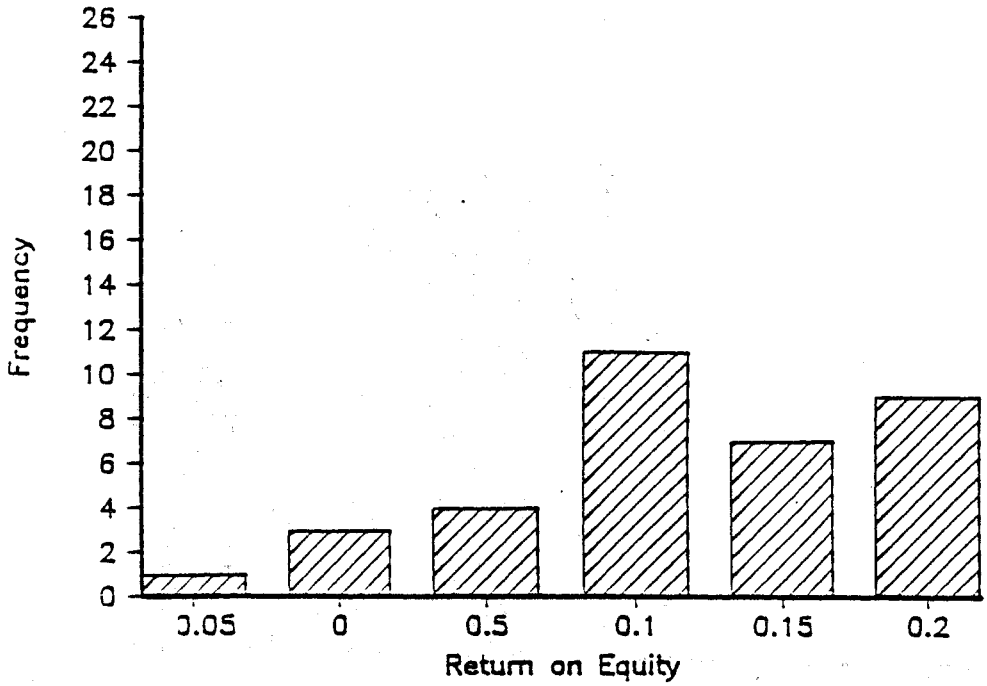


Figure 11. Return on Equity Before Mergers

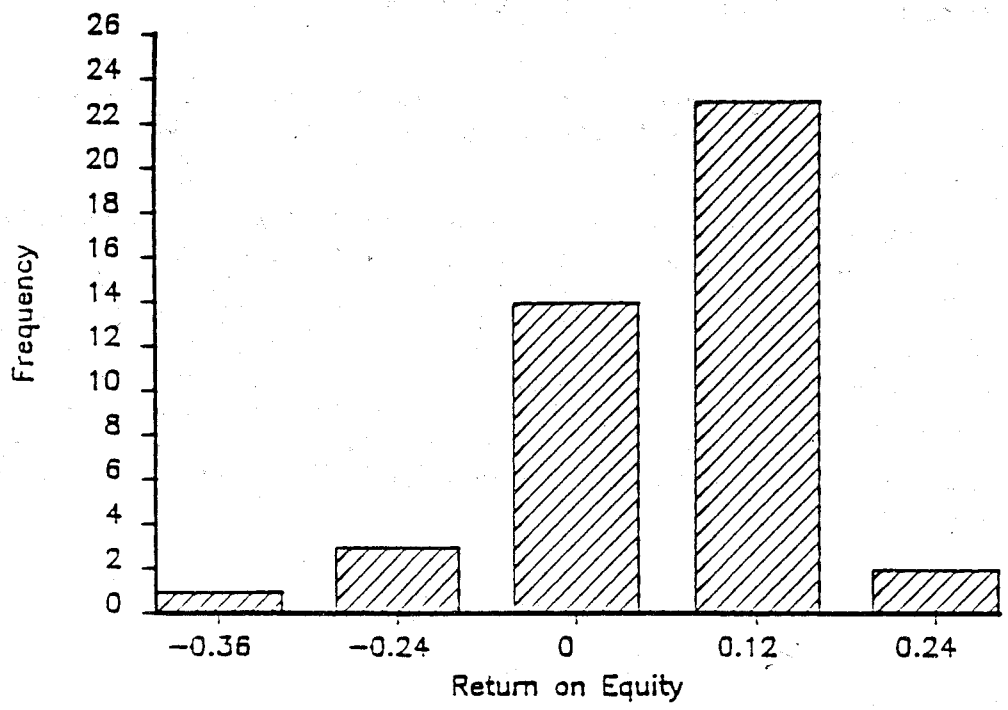


Figure 12. Return on Equity After Mergers

TABLE 17. CORRELATION COEFFICIENT TABLE

	Current Ratio	Debt/ Asset Ratio	Turnover Ratio	Fixed Asset Utilized	Total Asset Utilized	Return to Equity	Percent of Sales Revenue	Percent of Grain Revenue	Percent of Storage Revenue	Debt to Equity	Long-term Debt to Equity
Current ratio	1.00	-.59*	-.04	.03	.03	.19*	.05	.00	-.18*	-.47*	-.22*
Debt/asset ratio		1.00	.20*	.29*	.12*	.04	.15*	-.05	.09	.81*	.46*
Turnover ratio			1.00	.28*	.32*	.29*	-.16*	.20*	-.07	.15*	-.09
Fixed asset utilization				1.00	.65*	.18*	-.07	.20*	-.19*	.31*	-.24*
Total asset utilization					1.00	.08	-.00	.20*	-.04	.13*	.05
Return to equity						1.00	-.02	.28*	-.27*	.02	-.23*
Percent of sales revenue							1.00	-.80*	-.08	-.04	.17*
Percent of grain revenue								1.00	-.51*	-.04	-.08
Percent of storage revenue									1.00	.10	.09
Debt to equity										1.00	.43
Long-term debt to equity											1.00

*Significant at 5 percent level.

Correlation coefficients values generally were relatively low for most ratios. There exists a high correlation between return on equity and return on total asset (.85). Also, a high correlation exists between debt-to-equity and debt-to-total asset ratios (.91) indicating that both variables represent the same phenomena. As a result, only one variable was used in the multiple regression model presented below.

The percent of grain revenue to total revenue and percent of storage revenue are inversely related. Since the summation of the percent of grain revenue, storage revenue, and sales revenue equals 100, it would be expected that an inverse relationship exists. This is supported by the correlation coefficient value of -.51. The simple correlation results do indicate The simple correlation results do indicate that return to equity is positively (and significantly) influenced by the current ratio, the turnover ratio, fixed asset utilization, percent grain revenue and debt to equity. Ratios having negative impact on return on equity include percent storage revenue and long-term debt to equity. The t-values indicate whether a significant statistical relationship exists.

In Table 18, the results of simple regressions of return on equity with each independent variable are presented. The simple regression will indicate which variables are statistically significant to return on equity. A significant relationship exists between the following ratios and return to equity; current ratio, long-term debt to equity, fixed asset utilization, storage capacity, percent of grain revenue, percent of storage revenue, and percent of sales revenue. The only nonsignificant variables include; debt-to-equity ratio, debt-to-total asset ratio, and total asset utilization. It was observed that a positive relationship exists between return on equity and current ratio, fixed asset utilization, and percent of grain revenue to total revenue. A negative relationship was observed between return on equity and long-term debt-to-equity, percent of storage revenue, and percent of sales revenue to total revenue. As a result of the simple regression, financial and operating ratios have been identified that have the greatest impact on firm performance.

The simple regression models only tested the relationship between the variable in question and return on equity. Therefore, it is important to use multiple regression to identify the relationships between individual variables since firm type may influence these relationships.

The regression equation was estimated for the total sample and for single- and multiple-plant firms separately and are presented in Table 19. The F-ratio was significant at the 5 percent level for all three models and can be interpreted to mean that the statistical model can explain variations in return on equity with a high degree of reliability. The R^2 indicate the percent of the variation in return to equity explained by these equations.

For the total sample model, current ratio, long term debt-to-equity ratio, storage capacity turnover, percent of grain revenue to total revenue, and percent of sales revenue to total revenue, all are significant variables in explaining the variation of return on equity. The insignificant variables

TABLE 18. REGRESSION EQUATIONS OF SELECTED FINANCIAL RATIOS FOR THE SELECTED COOPERATIVE ELEVATORS, NORTH DAKOTA, 1978-1986

Independent Variable	Regression Equation	R^2
X_1 = Current ratio	$Y^a = .027 + .058X_1$ $(3.44)^b$**	.03
X_2 = Debt-to-equity ratio	$Y = .093 + .006X_2$ (1.00)	.003
X_3 = Long-term debt-to-equity ratio	$Y = .114 - .069X_3$ (-3.21)**	.03
X_4 = Debt-to-total-asset ratio	$Y = .077 + .046X_4$ (1.20)	.004
X_5 = Fixed asset utilization	$Y = .072 + .002X_5$ (2.84)**	.03
X_6 = Total asset utilization	$Y = .086 + .004X_6$ (0.78)	.002
X_7 = Storage capacity turnover	$Y = .068 + .008X_7$ (5.10)**	.16
X_8 = Percent of grain revenue to total revenue	$Y = -.007 + .199X_8$ (5.78)**	.09
X9 = Percent of storage revenue to total revenue	$Y = .158 - .371X_9$ (-6.19)**	.10
X_{10} = Percent of sales revenue to total revenue	$Y = .154 - .481X_{10}$ (-6.09)**	.10

**Significant at 5 percent level.
[a]Rate-of-return on equity.
[b]Values in parentheses represent computed t-values.

include fixed asset utilization, total asset utilization, and percent of storage revenue to total revenue.

The results indicate that if the current ratio increased by 1 unit, the return to equity would increase by .05. Since the t-value was 3.24, a significant statistical relationship does exist. Long-term debt-to-equity ratio represents solvency of the firm. A negative relationship exists between return to equity and long term debt-to-equity ratio where a 1 unit increase in long term debt-to-equity ratio would decrease return on equity by .06. Storage capacity turnover represents the asset management of the firm and was the only significant variable in its group. A coefficient value of .01 means that an averge return on equity increases by .01 percent for each 1 unit increase in its storage capacity turnover ratio. The coefficient value of .15 for percent of grain revenue indicates that a positive relationship exists between itself and return to equity. The interpretation is that an increase

TABLE 19. MULTIPLE REGRESSION OF SELECTED FINANCIAL RATIOS USING RATE OF RETURN ON EQUITY AS DEPENDENT VARIABLE, NORTH DAKOTA, 1978-1986

Selected Variables	Total Sample	Single Plant	Multiple Plant
Intercept	-.10 (1.71)	-.26** (2.56)	.03 (0.46)
Current ratio	.05** (3.24)	.09** (3.45)	.02 (1.07)
Long-term debt to equity	-.06** (2.74)	.05 (0.88)	-.08** (4.23)
Storage capacity turnover	.01** (4.64)	.01** (2.92)	.004 (1.08)
Fixed asset utilization	.0004 (0.43)	.001 (0.86)	.004** (2.36)
Total asset utilization	-.005 (0.85)	-.009 (1.39)	.005 (0.50)
Percent of grain revenue	.15** (2.50)	.27** (2.67)	.03 (0.42)
Percent of storage revenue	-.06 (0.77)	-.18 (1.25)	-.26** (2.75)
Percent of sales revenue	.16** (2.00)	.19 (1.34)	.12 (1.23)
R^2	.23	.21	.37
F-ratio	12.27	5.74	12.57

**Significant at 5 percent level.
Note: Values in parentheses represent computed t-values.

of 1 percent in grain revenue increases return on equity by .15 percent. Lastly, a positive relationship exists between percent of sales revenue to total revenue and return of equity as indicated by the positive coefficient value of .16. This means that a 1 percent increase in sales revenue would increase return on equity by .16 percent.

There was a noticeable difference between the single- and multiple-plant models with regard to significant ratios. For example in the single-plant model, current ratio, storage capacity turnover, and percent of

grain revenue to total revenue were statistically significant compared to the multiple-plant model where long term debt-to-equity, fixed asset utilization, and percent of storage revenue to total revenue were statistically significant. In all cases, the a priori expectations about the correct signs were observed. Therefore, it was observed and concluded that return on equity is affected by different financial and operating ratios by firm type.

III. Analysis of Costs and Cost Functions

Profitability of the industry is dependent, in part, on the cost structure of individual firms. The purpose of this section is to analyze the cost structure of the elevator industry by firm type. Since multiple-plant firms have more facilities to maintain (which require more personnel), it would be expected that the cost structure between firm types would differ. The analysis is divided into two sections. First, the cost components of interest, salary, repair, depreciation and insurance expense are presented, along with average total cost per bushel. For each of these components, data are presented yearly from 1978 to 1986. In section two, the relationship between cost and output is estimated from which marginal and average total costs are calculated.

The average total cost per bushel is influenced by the number of bushels handled by the firm. In Table 20 average costs are presented for both single- and multiple-plant firms. On the average, costs have doubled for multiple-plant firms. In 1978 the average cost per bushel was $.14 compared to $.31 for 1985. Since these costs are measured on a per bushel basis,

TABLE 20. AVERAGE TOTAL COST PER BUSHEL FOR COOPERATIVE ELEVATORS CLASSIFIED BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Year	Single Plant			Multiple Plant		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
	dollar/bushel					
1978	.15	.06	.35	.14	.08	.22
1979	.16	.08	.52	.17	.08	.27
1980	.21	.08	.79	.22	.09	.40
1981	.24	.10	.58	.25	.11	.42
1982	.25	.09	.77	.25	.12	.46
1983	.20	.07	.32	.21	.12	.40
1984	.21	.09	.32	.25	.12	.38
1985	.27	.09	.63	.31	.15	.47
1986	.23	.08	.41	.22	.08	.60

yearly fluctuations may be attributed in part to the number of bushels handled by a firm in the given year. In this section, total costs are defined as operating expense plus interest and depreciation expenses. The cost components presented in this section are in nominal terms. As in the case of per bushel cost for 1986, the throughput for most elevators was much higher when compared to 1985, which can explain lower per bushel costs.

The lower total cost per bushel could be attributed to the age of the existing firms. Only 15 multiple-plant firms existed in 1978 as compared to 20 for 1983. Those 15 firms were older, more established firms, which may have a lower depreciation schedule for their fixed assets. However, with the rise of merger activities during 1982 through 1985, the average cost was greater for multiple-plant firms as compared to single-plant firms. Inflation may be directly related to this rise, however, the total volume the firms were handling was fluctuating as shown in Table 21. As in the case of PIK in 1983 and in 1986, the number of bushels handled increased for most firms and is represented by lower per bushel costs.

In Table 22 the individual cost components are presented. With the rise of interest rates in the late 1970s and early 1980s, interest expense for both operating debt and long-term debt financing increased. For multiple-plant firms, interest expense rose from $.01 per bushel in 1978 to $.04 per bushel by 1982 as compared to $.01 per bushel in 1978 for single-plant firms to $.04 per bushel in 1981. Interest expense does not make up a large portion (about 10 percent) of the total cost for the elevator industry as shown in Table 23.

TABLE 21. AVERAGE TOTAL VOLUME BY FIRM TYPE

Year	Mean		Range			
			Minimum		Maximum	
	S	M	S	M	S	M
1978	1,536,394	2,542,717	455,734	763,027	3,565,727	8,409,866
1979	1,667,159	2,714,095	464,588	1,095,820	3,864,731	8,840,296
1980	1,649,750	2,424,638	384,456	1,380,966	4,959,023	7,228,885
1981	1,497,483	2,660,928	598,353	779,243	4,857,080	12,483,660
1982	1,595,577	3,627,567	528,911	1,194,073	6,097,283	14,093,593
1983	1,928,823	5,198,030	947,594	1,376,390	6,096,438	17,636,603
1984	1,983,724	4,447,512	768,075	1,239,720	5,998,122	19,453,887
1985	1,785,572	3,804,523	382,894	1,111,065	4,650,059	15,110,177
1986	1,979,401	6,863,863	675,747	1,402,218	4,065,618	27,224,525

Note: S = Single Plant; M = Multiple Plant.

TABLE 22. AVERAGE COST PER BUSHEL BY EXPENSE COMPONENT

Year	Interest		Depreciation		Insurance		Utilities		Salary		Repair		Miscellaneous	
	S	M	S	M	S	M	S	M	S	M	S	M	S	M
1978	.02	.01	.02	.02	.02	.01	.00[1]	.00	.05	.05	.01	.01	.03	.03
1979	.02	.02	.02	.03	.02	.02	.01	.01	.05	.06	.01	.01	.04	.04
1980	.03	.02	.03	.03	.02	.02	.01	.01	.06	.07	.01	.01	.06	.06
1981	.03	.04	.03	.04	.03	.03	.01	.01	.08	.08	.01	.01	.07	.07
1982	.03	.04	.03	.04	.02	.02	.01	.01	.08	.08	.01	.01	.07	.07
1983	.02	.02	.03	.04	.02	.02	.01	.01	.06	.07	.01	.01	.06	.06
1984	.02	.03	.03	.04	.02	.02	.01	.01	.07	.08	.01	.01	.06	.06
1985	.03	.03	.04	.05	.03	.03	.01	.01	.09	.10	.01	.01	.07	.07
1986	.02	.02	.04	.04	.03	.02	.01	.01	.08	.07	.01	.01	.06	.05

[1]Less than 1/2 cent.

Note: S = Single Plant; M = Multiple Plant.

TABLE 23. COST COMPONENTS AS PERCENT OF TOTAL COST, BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Year	Depreciation		Insurance		Interest		Utilities		Repairs		Salary		Miscellaneous	
	S	M	S	M	S	M	S	M	S	M	S	M	S	M
	percent													
1978	16	17	10	11	11	6	4	3	4	5	36	38	19	21
1979	14	15	10	11	10	8	3	4	5	5	33	36	25	21
1980	14	15	10	11	12	8	3	3	3	4	31	35	27	24
1981	14	15	10	11	11	11	3	3	4	4	30	32	28	24
1982	15	15	9	10	10	12	4	3	5	4	31	33	26	24
1983	15	17	7	8	9	8	4	4	3	4	32	34	30	25
1984	17	17	8	9	11	10	4	4	4	3	30	34	26	23
1985	17	17	9	9	10	9	4	4	3	4	31	34	26	23
1986	17	17	12	11	8	8	4	5	3	5	32	34	24	21

Note: S = Single Plant; M = Multiple Plant.

Depreciation expense represents an estimate of the decline in service potential of the asset occurring during the accounting period. There is a certain time frame in which an asset loses its value to the firm. As a result, the cost of these assets must be allocated to revenues over the limited duration of the asset's useful life. For both single and multiple-plant firms, depreciation expense has risen. For example, in 1978 the per bushel cost of depreciation was $.02 for both types of firms. However, by 1985, per bushel depreciation costs rose to $.04 for single-plant firms and $.05 for multiple-plant firms. Depreciation expense makes up on the average 17 percent of the total cost of both single- and multiple-plant firms (Table 23). Since depreciation is based on the value of the plant and equipment, it would be expected that newer facilities and plants that have made improvements would have a higher per bushel depreciation expense.

The average per bushel cost for salary expense is presented in Table 22. On average, salary expense has increased for both single- and multiple-plant firms. From the period between 1980 to 1985, multiple-plant firms had a higher salary cost per bushel as compared to single-plant firms. In 1986, with larger throughput, salary expense declined for multiple-plant firms and was less than single-plant firms. Throughout this time period, salary made up 33 percent of total cost for both single- and multiple-plant firms. Therefore, it can be concluded that as grain throughput increases, multiple-plant firms are more capable of utilizing their facilities and labor force.

Utilities, repair, insurance, and miscellaneous expense make up the majority of variable costs in this study. As shown in Table 23, both utilities and repair expense average $.01 a bushel for single- and multiple-plant firms. Also, utilities and repair expense make up about 4 percent of the total cost, respectively.

Insurance expense has been rising since 1978 from $.02 per bushel for single-plant and $.01 per bushel for multiple-plant firms to $.03 per bushel by 1985 for both types of firms. Even with the rise, insurance expense only comprises 10 percent of the total cost for both types of firms. The rise in insurance expense can be directly related to a number of factors, most importantly inflation, which has increased the valuation of the plant and equipment, construction, and merger of cooperatives. In any case, if the cooperative's asset value increases, this would increase the insurable value of the firm. As a result, insurance expense has risen for both firm types.

Lastly, miscellaneous expense is comprised of any component of total expense that was not catergorized in the above. For the most part, miscellaneous expense has risen from $.03 a bushel in 1978 to $.07 a bushel by 1985. Miscellaneous expense comprised by 19 to 30 percent of total costs in a given year. Therefore, miscellaneous expense was the second largest component of total cost in this study.

Cost Functions

In this section, the relationships between output and costs are analyzed. The organization of this section is as follows: 1) estimation of empirical model, 2) presentation of statistical results, and 3) the economic interpretation of results.

Model Estimation

Empirical studies of cost functions examine the relationship between costs and output. A long-run cost curve can be estimated using cross-sectional data on firms in the industry, specifically data on total costs, output, and other relevant variables (Intriligator). Meyer concluded in a 1954 study that when estimating cost functions using cross-section data, the results are long-run cost curves while time-series data represented short-run cost curves. Furthermore, in the long run, firms are assumed to have no fixed cost since all costs are variable. Hence, to estimate a long-run cost function, the following assumptions must be made: 1) the same technology applies to all firms, 2) observed output must be close to planned output level, and 3) firms are seeking to minimize cost at each planned output level (Intriligator). For the country grain elevator industry, the above assumptions are believed to hold true. Therefore, the following cost functions are assumed to be long-run due to the nature of having both time-series and cross-sectional data.

It is important to stress that a number of problems may result in the use of cross-sectional data. In one study, Walters addressed shortfalls due to random influences that effect the level of firm output. As a result, cost estimates can be distorted. In a second study, Stollsteimer et al., stressed that caution should be taken in interpretation of results of cost functions due to problems associated with model mispecification and sampling size.

Total costs were inflated to 1985 using the Producer Price Index for intermediate produced goods. A scatter gram of total costs is presented in Figure 13 for single- and Figure 14 for multiple plants. The majority of observations are located between 250,000 to 3,000,000 bushels for single-plant and 500,000 to 8,000,000 bushels for multiple-plant firms. The observations were pooled from 1978 to 1985 and the cost data was inflated to 1985 dollars using wholesale price index for intermediate goods. Since single- and multiple-plant firms are assumed to have different cost structures due to physical characteristic differences, separate cost functions are estimated. The country grain elevator is involved in providing a number of services to their farmer patrons. However, the majority of revenue and ultimate expense is incurred through two of these activities, that being handling (merchandising) of grain and storage. Therefore, output produced from these two activities potentially affect the level of cost and are incorporated into

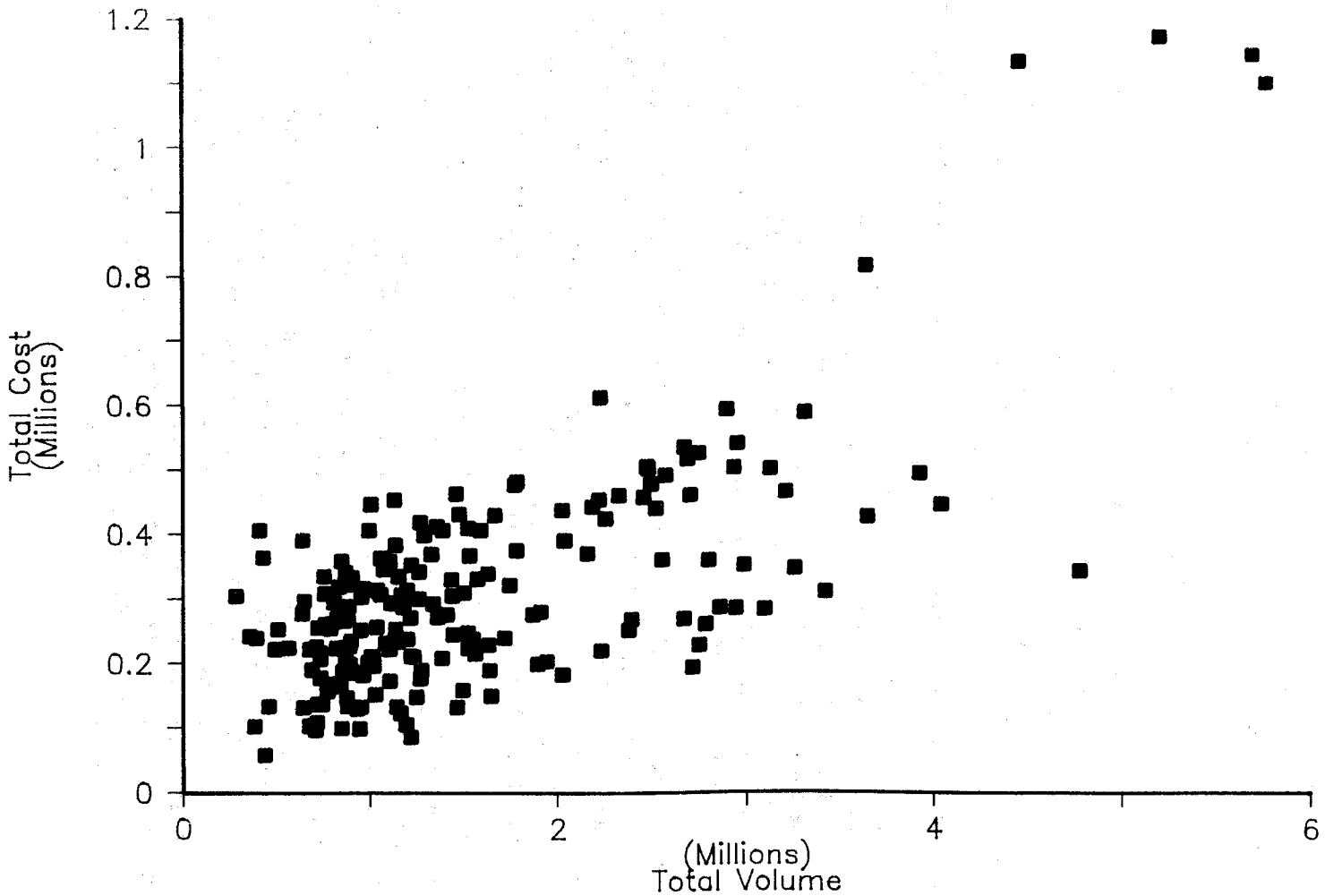


Figure 13. Scattergram of Total Cost for Single-Plant Firms

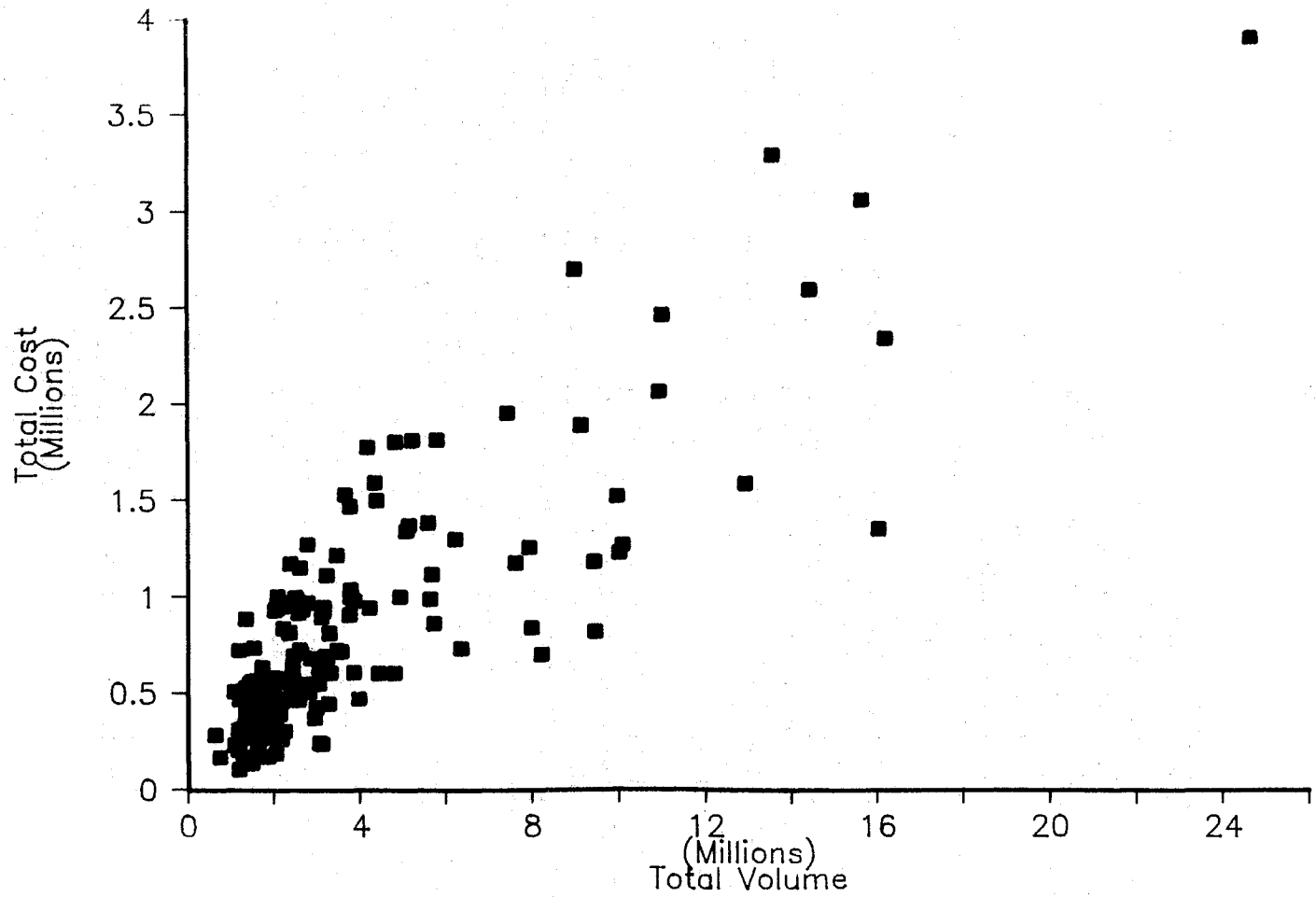


Figure 14. Scattergram of Total Cost for Multiple-Plant Firms

a multiple output cost function. The following cost functions were estimated for single- and multiple-plant firms.

1) $TC = \beta_0 + \beta_1 FNUM + \beta_2 TOTV + \beta_3 TOTV^2 + \beta_4 TOTV^3$
2) $TC = \beta_0 + \beta_1 FNUM + \beta_2 BUSSY * TOTV + \beta_3 TOTV + \beta_4 TOTV^2 + \beta_5 TOTV^3$
3) $TC = \beta_0 + \beta_1 BUSSY + \beta_2 BUSSY^2 + \beta_3 BUSSY^3 + \beta_4 TOTV + \beta_5 TOTV^2 + \beta_6 TOTV^3$

where

TC = Total costs
FNUM = Number of plants
BUSSY = Bushels stored yearly
$BUSSY^2$ = Bushels stored yearly squared
$BUSSY^3$ = Bushels stored yearly cubed
TOTV = Total volume
$TOTV^2$ = Total volume squared
$TOTV^3$ = Total volume cubed
BUSSY * TOTV = Interaction between bushels stored yearly times total volume

For single-plant firms the variable, FNUM=1 was deleted from models 1 and 2. The cubic model was chosen for both firm types due to the simplicity of estimation. Due to problems associated with multicollinearity, separate model specifications were required for single- and multiple-plant firms and are presented in Appendix Table 4. Each model was estimated using total cost less depreciation expense (TC), since depreciation expense does not require an actual cash outlay.

The variables that were selected for each model were based on the business activities of the sample of firms. For example, the variable BUSSY is defined as total storage revenue divided by $0.36/bushel/year. The $0.36 represents the yearly storage revenue earned from one bushel of grain stored. Therefore, BUSSY represents the number of bushels that the firm stored during a given year. Two additional variables were included in the cost functions. The variable FNUM represents the number of physical plants that are owned by the multiple-plant firms. The logic being that a greater number of physical plants results in potentially greater costs. The second variable BUSSY * TOTV is defined as total volume (TOTV) multiplied by bushels stored yearly (BUSSY). The reasoning for including this variable is to capture the interaction between these two business activities. In this case, questions regarding marginal cost for each additional bushel of working space may be addressed.

Statistical Results

The results of the estimated models are presented in Appendix Table 4. Model 3 provided the best statistical results for single-plant firms. Each variable was found to be statistically significant at the 5 percent level. Furthermore, all a priori expectations about the signs for each coefficient were correct. The observed R^2 for model 3 was .70 percent which indicates the

model represents a fairly accurate measurement of the single-plant cost structure.

As stated earlier, due to problems associated with multicollinearity, model 3 was not estimated for multiple-plant firms. Therefore, it was observed that model 1 provided the best statistical results. All of the variables with the exception of total volume cubed were statistically significant at a 5 percent level. The R^2 for model 3 was .87 percent which indicates that the model represents the cost movements for multiple-plant firms with a high degree of certainty.

Economic Interpretation

The purpose of estimating a cost function is to analyze the cost-output relationship of business activities of the firm. From the above regression models, both marginal and average costs can be statistically estimated for single- and multiple-plant firms at each expected level of output. Furthermore, questions regarding economies of size can be answered through estimating cost curves and elasticity coefficients.

Average and marginal cost were derived from model 3 for single-plant and model 1 for multiple-plant firms for illustrative purposes.[1] Average cost function was derived by taking the total cost function and dividing the right-hand variables by total volume for the grain handling activity and bushels stored yearly for the storage activities.

Single-Plant

$AC = \beta_1 + \beta_2 \text{ TOTV} + \beta_3 \text{ TOTV}^2$ (Grain Handling)

$AC = \beta_1 + \beta_2 \text{ BUSSY} + \beta_3 \text{ BUSSY}^2$ (Storage)

Multiple-Plant

$AC = \beta_2 + \beta_3 \text{ TOTV} + \beta_4 \text{ TOTV}^2$ (Grain Handling)

The marginal cost function was derived by taking the first partial derivative of the total cost function with respect to total volume and storage:

Single-Plant

$MC = \beta_1 + 2\beta_2 \text{ TOTV} + 3\beta_3 \text{ TOTV}^2$ (Grain Handling)

$MC = \beta_1 + 2\beta_2 \text{ BUSSY} + 3\beta_3 \text{ BUSSY}^2$ (Storage)

Multiple-Plant

$MC = \beta_2 + 2\beta_3 \text{ TOTV} + 3\beta_4{}^3 \text{ TOTV}^2$ (Grain Handling)

---

[1]Results from model 2 are not interpreted or presented in this section. However, model specification can be interpreted that the marginal costs of handling depends on how much is stored and the marginal cost of storage depends on how much is handled.

Both the average and marginal costs for grain handling are presented in Table 24 and plotted in Figure 15 for single-plant firms. The minimum efficient scale of plant is the point where average costs are minimized. This is at $.05 per bushel when total grain volume reaches 3 million bushels (Figure 15). However, if a firm could choose the size of plant and planned level of output, they would operate at 3.25 million bushel where marginal cost equals average cost. At this point, average total cost is minimized with respect to output. As output increases, average and marginal costs increase.

Average total costs are presented in Table 25 along with marginal cost data for multiple-plant firms. For multiple-plant firms, the minimum average total costs are reached at $.09 per bushel at 17 million bushels (Figure 16). At this point, the minimum efficient scale of plant is achieved for multiple-plant firms. However, if a firm had a choice on the plant size, it would choose a size that would be able to operate at 21 million where marginal and average costs intersect. Figure 17 represents model 1 for single-plant firms. Since storage is not in the model, total average costs are $0.09/bushel at 3.25 million bushel.

TABLE 24. ESTIMATED AVERAGE AND MARGINAL COST AND ELASTICITY OF COST FOR SINGLE-PLANT FIRMS, GRAIN HANDLING

Total Volume	Average Cost	Marginal Cost	Elasticity
	---------dollars/bushel---------		
250,000	0.09	0.08	0.89
500,000	0.08	0.07	0.88
750,000	0.08	0.06	0.75
1,000,000	0.07	0.05	0.72
1,250,000	0.06	0.04	0.67
1,500,000	0.06	0.03	0.50
1,750,000	0.06	0.03	0.50
2,000,000	0.05	0.03	0.60
2,250,000	0.05	0.03	0.60
2,500,000	0.05	0.03	0.60
2,750,000	0.05	0.04	0.80
3,000,000	0.05	0.04	0.80
3,250,000	0.05	0.05	1.00
3,500,000	0.05	0.07	1.40
3,750,000	0.05	0.08	1.60
4,000,000	0.05	0.10	2.00
4,250,000	0.05	0.12	2.40
4,500,000	0.06	0.14	2.53
4,750,000	0.06	0.16	2.67

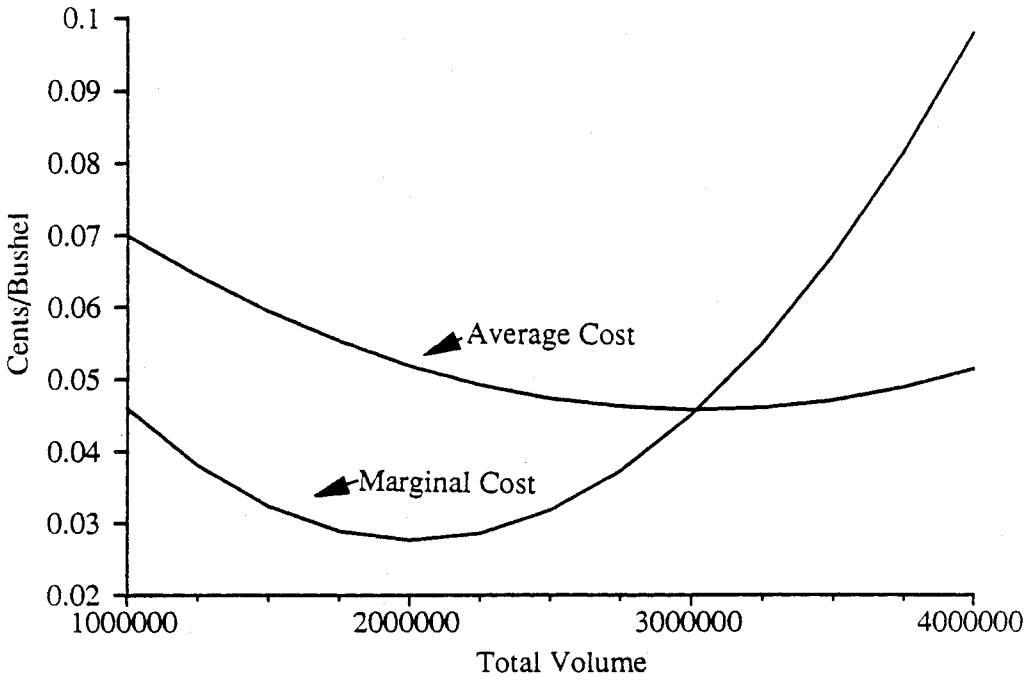


Figure 15. Estimated Average and Marginal Cost from Model 3 for Single-Plant Firms

From the estimated cost curves, the questions regarding economies of size can be answered. The measure of economies of size is given by the elasticity of cost (i.e., elasticity of the cost curve with respect to output).

Elasticity = MC/AC

where:

Economies of scale < 1

Constant returns to scale = 1

Diseconomies of scale > 1

The coefficient value of the elasticity of total cost with respect to output was .50 for single-plant firms given the average level of grain throughput of 1.5 million bushels from Table 24. To lower per unit average costs, the total volume of grain the firm handles must be increased to a level

TABLE 25. ESTIMATED AVERAGE AND MARGINAL COST AND ELASTICITY OF COST FOR MULTIPLE-PLANT FIRMS, GRAIN HANDLING

Total Volume	Average Cost	Marginal Cost	Elasticity
	----------dollars/bushel----------		
1,000,000	0.22	0.20	0.94
2,000,000	0.20	0.18	0.88
3,000,000	0.19	0.16	0.81
4,000,000	0.18	0.14	0.75
5,000,000	0.17	0.12	0.69
6,000,000	0.16	0.10	0.63
7,000,000	0.15	0.09	0.58
8,000,000	0.14	0.07	0.53
9,000,000	0.13	0.06	0.48
10,000,000	0.13	0.06	0.45
11,000,000	0.12	0.05	0.42
12,000,000	0.11	0.05	0.41
13,000,000	0.11	0.05	0.42
14,000,000	0.10	0.05	0.44
15,000,000	0.10	0.05	0.48
16,000,000	0.10	0.05	0.54
17,000,000	0.09	0.06	0.63
18,000,000	0.09	0.07	0.73
19,000,000	0.09	0.08	0.86
20,000,000	0.09	0.09	1.00
21,000,000	0.09	0.11	1.16
22,000,000	0.09	0.12	1.34
23,000,000	0.09	0.14	1.51

where average costs and marginal cost intersect. When a firm operates at a total volume greater than their minimum average cost, for example at 3.5 million bushels, the coefficient of elasticity of 1.4 for single-plant firms indicates diseconomies of scale. In the long run, diseconomies of scale are associated with coordinating of activities, conveying information, and carrying out managerial directives. The firm becomes inefficient and as a result, the average total cost begins to rise proportionately more than total output.

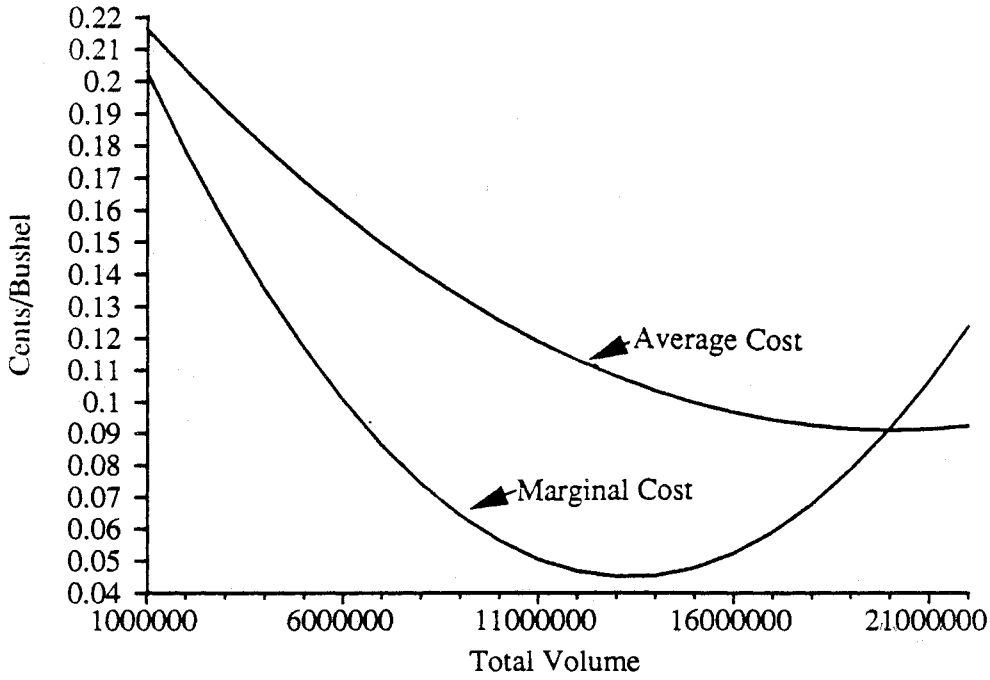


Figure 16. Estimated Average and Marginal Cost from Model 2 for Multiple-Plant Firms

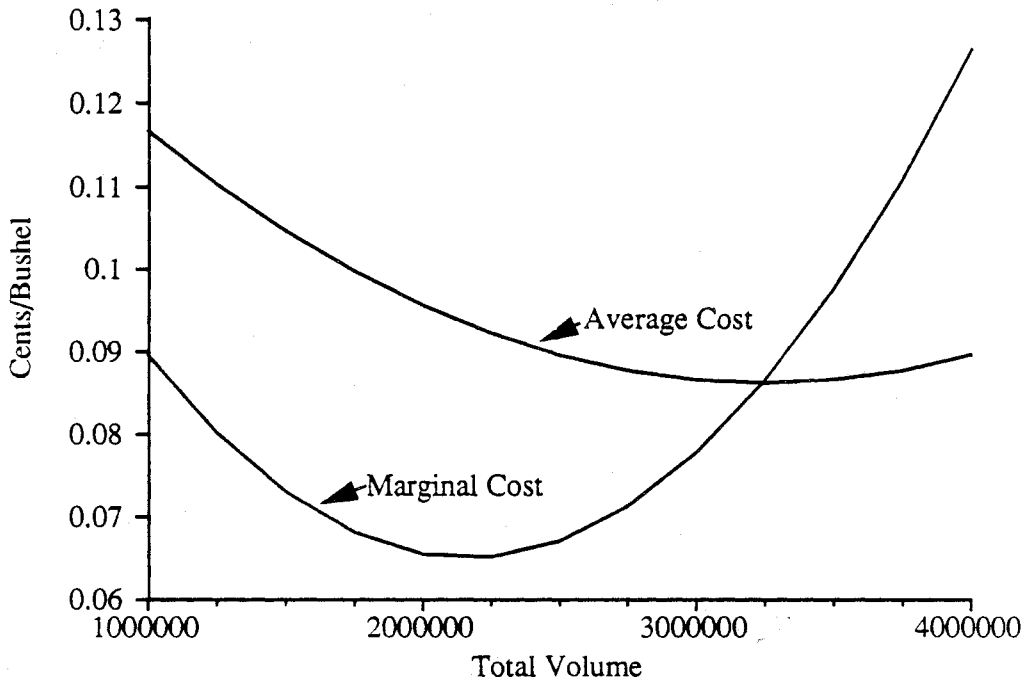


Figure 17. Estimated Average and Marginal Cost from Model 1 for Single-Plant firms

Multiple-plant firms, in this case, operate at the mean level of grain throughput of 3.7 million and the value of the elasticity was .75 (Table 25). Economies of size exist throughout the given range of grain throughput up to 22 million bushels. At that level of output and greater, diseconomies of scale began to occur.

The second source of business activity of a country grain elevator is grain storage. Both the average and marginal costs for grain storage are presented in Table 26 for single-plant firms. For single-plant firms, the minimum efficient scale of plant can be reached when the average yearly costs are at $.29 per bushel at 600,000 bushels of stored grain yearly. However, in the long run, if a single-plant firm had a choice, they would want to store between 650,000 and 700,000 bushels where marginal and average costs intersect at $.29 per bushel.

TABLE 26. ESTIMATED AVERAGE AND MARGINAL COST FOR SINGLE-PLANT FIRMS, STORAGE

Bushel Stored Per Year	Average Cost	Marginal Cost
	---- $/bushel per year -----	
50,000	0.61	0.56
100,000	0.56	0.46
150,000	0.51	0.38
200,000	0.47	0.32
250,000	0.44	0.26
300,000	0.40	0.22
350,000	0.37	0.19
400,000	0.35	0.17
450,000	0.33	0.16
500,000	0.31	0.17
550,000	0.30	0.18
600,000	0.29	0.21
650,000	0.29	0.25
700,000	0.29	0.31
750,000	0.29	0.37
800,000	0.30	0.45

Conclusions

The cost structures between single- and multiple-plant firms differ in magnitude. Multiple-plant firms must handle up to seven times their grain storage capacity as compared to a single-plant firm to reach a minimum average cost (minimum efficient scale) in grain handling. The minimum average cost for a multiple-plant firm is $.09 per bushel at 20 million bushels compared to $.05 per bushel at 3.25 million bushels for single-plant firms. As shown in Table 21, at no time has the average been close to 22 million bushels for multiple-plant firms.

The difference in cost structures may be attributed to the fact that multiple-plant firms have higher-cost fixed assets. Since multiple-plant firms are comprised of a number of physical plants, each of these plants have a distinct cost structure. As a result, each plant may not draw enough grain throughput to allow the plant to operate efficiently.

Another factor that may influence differences in cost structures is the debt structure of the multiple-plant firm. During the early 1980s, interest rates were at record levels. A number of mergers occurred during this time which may have required the use of debt financing. That has resulted in a number of those firms experiencing the difficulty of debt repayment. Therefore, the sample of multiple-plant firms in this study may have a higher cost structure resulting from a higher debt obligation than single-plant firms.

Single-plant cooperatives have a cost advantage due to the lower throughput requirements to achieve minimum costs. As a result, single-plant firms can better utilize their plant. Labor and equipment utilization are not burdened by a large amount of fixed assets as compared to multiple-plant firms. The fixed asset burden is even more evident when analyzing the cost structure for storage. Since multiple-plant firms are not able to fully achieve a cost advantage, their financial performance in most recent years has declined.

IV. Summary

The market structure of the country elevtor industry has undergone a dramatic change since the turn of the century. Since 1915, the number of licensed country elevators has declined from 2,031 to 573 in 1986. This decline was attributed to a number of factors. A few of these factors include technological improvements in production practices, improvement in transportation, declining farm numbers, and the role of government farm programs. Due to these factors the trend this century has been towards fewer elevators which are larger in physical size. As of 1986, the average storage capacity for a grain elevator in North Dakota was 411,000 bushels.

In recent years, with the introduction and adoption of multiple-car loading facilities, the elevator industry has been going through a transitional period. Cooperative unit-train shippers have evolved into either single-plant or multiple-plant firms. As firms become more competitive, the

number of mergers has risen. As a result of mergers in the industry, the number of firms have been declining, which has increased the level of concentration throughout the western and north central portion of the state. Since unit-train loading is a relatively new concept in the elevator industry in North Dakota, the effects on market structure, which ultimately affects the financial performance of the firms in the industry, have not been comprehensively researched.

The overall purpose of this study was to analyze the financial performance of the country grain handling industry in North Dakota during this time period. Specific objectives included:

1) Calculation of appropriate ratios and analyzing financial and operating performance of the country grain handling industry in North Dakota and identification of changes occurring through time.

2) Analyzing costs and cost functions for the industry.

The analysis and results reported in this study are limited to cooperatives in North Dakota for the period 1978-1986. Cooperatives comprise approximately 70 percent of the elevators in North Dakota, therefore the results from this analysis form a good representation of the trends in the North Dakota grain industry. Sources of secondary data came from the North Dakota Grain Dealers Annual Handbook and North Dakota Agricultural Statistics. The primary source of data was provided in the form of financial statements from 45 cooperatives over the period of 1978 to 1985. From the data base, the following analysis was performed: financial ratio analysis and cost structure analysis. The financial ratio analysis, based on both financial and operating ratios, was used to analyze firm types and events that occurred in the grain elevator industry. These events included before and after 1982 and before and after mergers. The individual ratios were grouped into four types: 1) liquidity, 2) solvency, 3) asset management, and 4) profitability. The cost structure of the industry was analyzed for individual cost components and by firm type. Cost functions were estimated using cost data from individual firms. Both average total and marginal cost functions were calculated by firm type. From the average total costs and marginal costs, minimum costs and the optimal throughput levels were calculated, along with cost elasticities.

Conclusions

From the analysis of financial ratios, significant differences were found to exist between firm types. Single-plant firms were found to utilize their physical plants more efficiently, as reflected by higher fixed asset utilization and storage capacity turnover ratios. Also, return on equity was greater for single-plant firms, as compared to multiple-plant firms in more recent years. The rate of return on equity and percent of grain revenue has declined on average after 1982, a period concurrent with significant changes in the competitive and operating environment of the industry. It was observed that merger activities of a select group of elevators were found to increase the range of return on equity of the newly created merged firm. Therefore, when firms merged, in general, return to equity declined.

The cost structure was analyzed for both single- and multiple-plant firms. The average cost over time has risen for both types of firms. This is the result of inflationary pressure during the period of time. Components that make up total cost include insurance, salary, utility, interest, repair, and miscellaneous expenses. It was found that a long-run cubic cost function (total cost less depreciation) provided the best estimated model. From the long-run cost function, both marginal and average total cost were calculated for grain handling and storage activities for both the single- and multiple-plant firms. The cost structure for the single-plant firm was found to be lower in the case of the storage activity in comparison to the multiple-plant firm. The multiple-plant firm had a constant cost of $.55 per bushel stored per year, compared to a minimum average and marginal cost of $.29 per bushel per year for single-plant firms. In grain handling, single- and multiple-plant firms had minimum average and marginal costs at $.05 per bushel at 3.25 million and 22 million bushels of throughput, respectively.

Implications

These results provide needed insight into the financial condition of the elevator industry in areas such as profitability, asset management, solvency, and liquidity. Commission firms and lenders may be interested in the results of the industry as a whole. The results provide information that would be useful in comparing financial and operating performance of individual firms and businesses to industry norms and advise firms of financial shortcomings. Also, when commission firms are addressing the issues of merger activities with affiliate cooperatives, the results may provide insight and guidelines based on financial performance of existing firms.

For the individual firms, industry norms that were identified from financial and operating ratios in this study provide a guideline to compare financial operating performances. For managers, being able to identify areas of weakness from these guidelines could help in improving management decisions.

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Appendix

APPENDIX TABLE 1. TESTS OF LIQUIDITY AND SOLVENCY, YEARLY AVERAGE, BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Year	Liquidity		Solvency					
	Current Ratio		Debt to Asset		Debt to Equity		Long-Term Debt	
	S	M	S	M	S	M	S	M
1978	1.32	1.36	.56	.49	1.56	1.09	.19	.08
1979	1.21	1.29	.53	.51	1.33	1.18	.18	.12
1980	1.33	1.34	.53	.56	1.39	1.56	.16	.25
1981	1.37	1.28	.51	.51	1.27	1.18	.15	.18
1982	1.43**	1.17	.48	.53	1.19	1.27	.15	.21
1983	1.29*	1.15	.55	.59	1.49	1.57	.15	.20
1984	1.26	1.21	.55	.53	1.60	1.38	.19	.25
1985	1.27	1.26	.52	.51	1.27	1.36	.17	.27
1986	1.27	1.17	.55	.56	1.36	1.49	.12	.23
Average	1.32**	1.23	.52	.53	1.38	1.36	.16	.21

*Significant at 10 percent level.
**Significant at 5 percent level.

Note: S = Single Plant; M = Multiple Plant.

APPENDIX TABLE 2. TEST OF ASSET MANAGEMENT, YEARLY AVERAGE, BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Year	Turnover Ratio		Total Asset Utilization		Fixed Asset Utilization	
	S	M	S	M	S	M
1978	4.58	4.52	2.95*	2.30	15.84*	10.89
1979	5.23	4.48	3.80*	2.50	19.14	13.46
1980	5.03*	3.88	3.66**	2.56	18.81*	13.15
1981	4.20	3.68	3.48**	2.42	15.90**	10.48
1982	4.37*	3.35	3.67**	2.45	15.55**	9.00
1983	4.60	4.31	3.58**	2.77	15.43**	10.06
1984	4.32*	3.38	3.23	2.73	12.05**	8.55
1985	5.67	2.72	2.85**	2.13	9.40**	6.19
1986	3.95	4.95	2.61	2.40	12.22	8.46
Average	4.68**	3.87	3.35**	2.48	15.21**	9.71

*Significant at 10 percent level.
**Significant at 5 percent level.

Note: S = Single Plant; M = Multiple Plant.

APPENDIX TABLE 3. TESTS OF PROFITABILITY, YEARLY AVERAGE, BY FIRM TYPE, NORTH DAKOTA, 1978-1986

Year	Return to Equity		Return to Assets		Grain Revenue		Storage Revenue		Sales Revenue	
	S	M	S	M	S	M	S	M	S	M
1978	.11	.12	.06	.06	.63	.63	.11	.10	.14	.10
1979	.16	.18	.10	.10	.66	.70	.11	.06	.14	.10
1980	.19	.18	.10	.09	.60	.60	.12*	.08	.14	.10
1981	.11	.12	.07	.07	.50	.52	.12	.11	.16	.10
1982	.05	.04	.05	.04	.47	.53	.18	.17	.14	.11
1983	.09	.09	.06	.05	.55	.56	.19	.16	.12	.11
1984	.07	.03	.04	.03	.52	.50	.19	.20	.13	.12
1985	.08	.05	.05	.04	.41*	.47	.26	.23	.12	.11
1986	.15	.08	.08	.05	.40	.44	.31	.27	.09	.08
Average	.11	.09	.05	.04	.53	.54	.17	.16	.13**	.11

*Significant at a 10 percent level.
**Significant at a 5 percent level.

APPENDIX TABLE 4. ESTIMATED COST FUNCTION FOR SINGLE- AND MULTIPLE-PLANT FIRMS

Variable	Single Plant			Multiple Plant		
	1	2	3	1	2	3
Intercept	100,415.72* (2.45)	111,899.09* (3.12)	51,670.38 (1.39)	-206,409.62* (2.92)	-108,814.24* (1.67)	
FNUN				80,813.54* (7.72)	38,894.83* (3.35)	
BUSSY * TOTV		1.17E-07* (7.87)			4.47E-8* (6.10)	
BUSSY1			.73* (3.98)			
BUSSY2			-1.27E-6* (2.38)			
BUSSY3			9.07E-13* (2.37)			
TOTV	.15* (2.59)	.12* (2.45)	.14* (2.76)	.23* (5.72)	.23* (6.43)	
TOTV2	-3.93E-8* (1.76)	-3.84E-8* (1.97)	-4.59E-8* (2.38)	-1.39E-8* (2.49)	-1.64E-8* (3.27)	
TOTV3	6.06E-15* (2.50)	4.13E-15* (1.94)	6.67E-15* (3.18)	3.48E-16* (1.66)	(2.67E-16) (1.43)	
R^2	.60	.70	.70	.84	.87	
F-Ratio	98.74	112.89	78.99	185.74	193.91	

*Significant at 10 percent level.